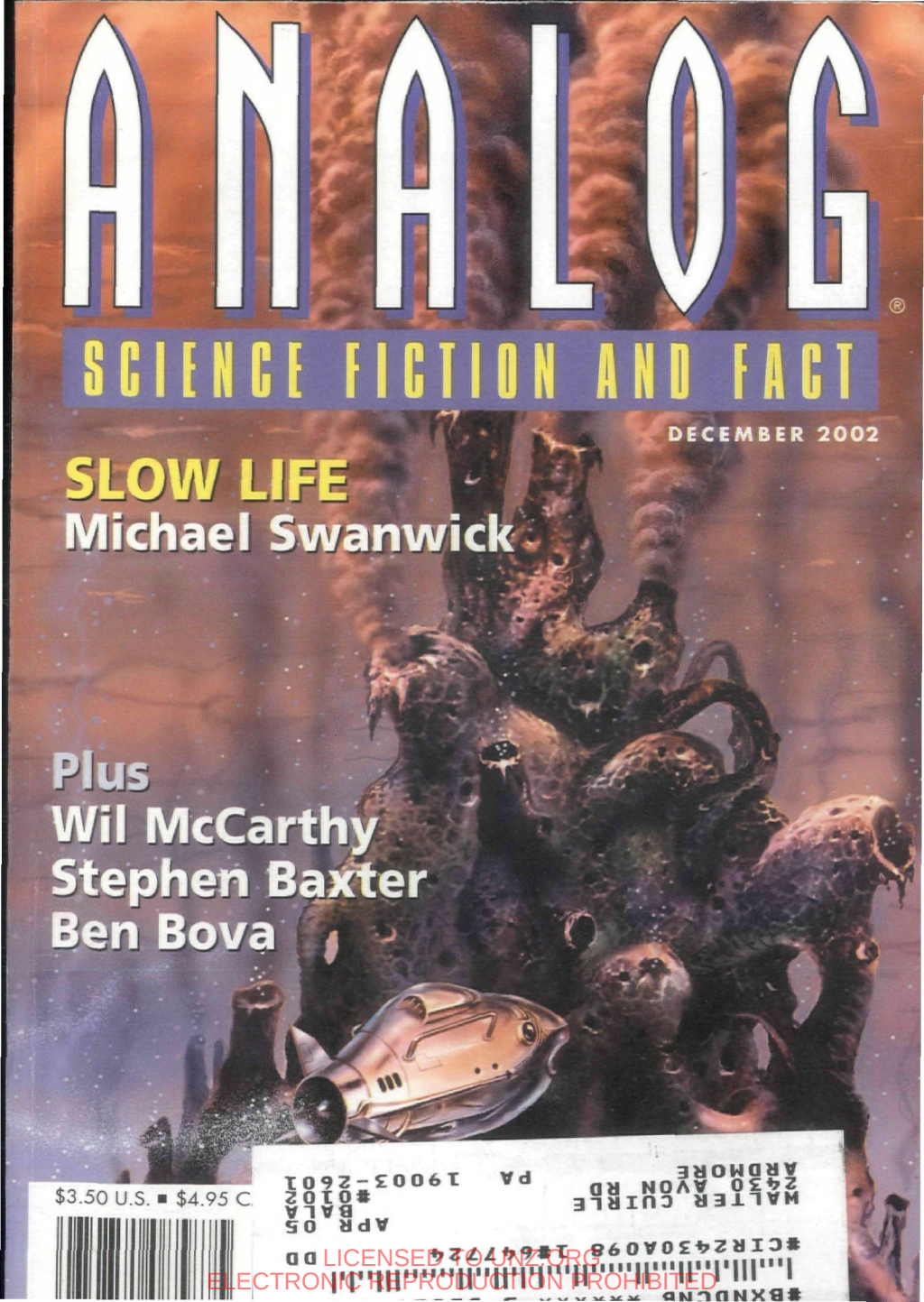
ANALOG

SCIENCE FICTION AND FACT

DECEMBER 2002

SLOW LIFE
Michael Swanwick

Plus
Wil McCarthy
Stephen Baxter
Ben Bova



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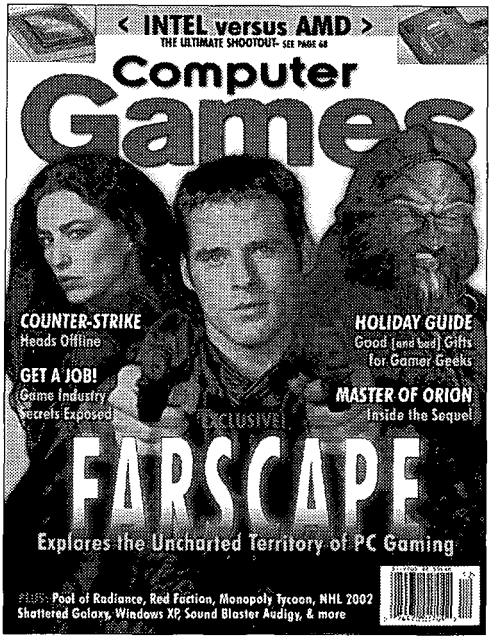

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December 2002

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DESIGN FLAW

The April 2002 issue of *Natural History* featured an intriguing and important cluster of essays about a recent "scientific" fad called "intelligent design," which one of the essays, by Barbara Forrest, aptly calls "the newest evolution of creationism." It would be tempting, for scientifically minded folk who have groaned through previous efforts to foist "fundamentalist" forms of "creation science" on unsuspecting students, to laugh this off and hope it will soon go away. Maybe it will, but that seems a dangerous assumption.

The current form of "intelligent design theory" seems to be winning considerable support in places where earlier versions of "creation science" didn't get very far, including the Ohio state legislature and the United States Congress. Perhaps this has something to do with the fact that some of its proponents have doctorates in scientific fields, and people often attach more significance to doctorates than they should. I can assure you from firsthand personal knowledge that it's quite possible to find holders of Ph.D. degrees who believe almost anything, and can make what sounds like an overwhelming case for it. Some people with a big axe to grind may actually go so far as to earn a Ph.D. just to gain the credibility it often confers. Professor (of philosophy) Forrest quotes one prominent intelligent design advocate as saying that he got doctorates in religious studies and biology specifically "to devote my life to destroying Darwinism."

I respectfully submit that this is not a particularly laudable reason for going into science, which is supposed to be about improving our understanding of the Universe rather than campaigning for the universal acceptance of this belief system or the destruction of that one. For me, such an admission immediately calls into serious question the motivations, and therefore the scientific claims, of whoever makes it. It does *not* mean his claims are necessarily wrong, or justify dismissing them unheard. If the intelligent design theorists really have a solider case than evolutionists, then it *should* have a place in our curricula—but if they don't, it shouldn't.

Therefore I urge you, if you have not already read these articles, to dig that issue of *Natural History* out of your own files or the nearest public library, read them all, and draw your own conclusions. They do represent "both" sides of the question, with three position papers by leading advocates of intelligent design, each accompanied by a rebuttal from an evolutionary scientist.

I am not going to attempt a comprehensive analysis of the whole debate here, or even a summary of everything said in the *Natural History* articles. All I propose to do is give one example, from one of the pairs of essays, of the kinds of arguments being invoked—and point out what seems to me one very basic and overwhelming logical flaw in the intelligent design "explanation."

The basic point of the intelligent design movement is the contention that (as summarized by *Natural History* Edi-

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tor-in-Chief Ellen Goldensohn) "the complexity of the natural world is evidence of planning by a higher intelligence." For example, biochemist Michael J. Behe argues that systems often show what he calls "irreproducible complexity," meaning, in simple terms, that you can't take away any of their parts and have them function at all—and therefore they can't have arisen by "numerous, successive, slight modifications" (Charles Darwin's words). As a nonbiological analog and instructive example, he considers the old-fashioned mousetrap, a mechanical system with five parts, all essential to its operation. "You can't catch a mouse with just a platform," Behe writes, "then add a spring and catch a few more mice, then add a holding bar and catch a few more. All the pieces have to be in place before you catch any mice."

True, but irrelevant and misleading. Biologist Kenneth R. Miller (who agrees with much of Behe's philosophy but doesn't buy his science) uses Behe's own mousetrap analogy to point out the false assumption in that reasoning: "that every piece of a machine . . . must be assembled in its final form before *anything* useful can emerge." Behe is quite right that you can't take away any part of a mousetrap and still have a mousetrap; but Miller is right that you can take away one or more of the parts and be left with a system capable of functioning as something *other* than a mousetrap, like a tie clip or fishhook or paperweight. And that (in reverse) is more like the way evolution works. You don't start with a crude (metaphorical) mousetrap and add successive modifications to make more effective mousetraps. You do something even more impressive (and easily modeled with the literal mousetrap): you start with a system that does one thing, add a modification, and thereby turn it into a new system that does something new and different.

Both Behe and Miller, and the other participants in this journalistic symposium, have considerably more to say in support of their positions. I urge you yet again to read—critically—what all of them have to say. They may or may not convince you that the complexity of the natural world (of which we are a small part) requires (or doesn't require) an intelligent designer. I won't attempt to decide that question here. I'll even grant, for the sake of argument, that it may be true.

My fundamental problem with it is this: *Even if our world is the product of intelligent design, that doesn't really answer the ultimate question of where did it all come from.* Or, to look at it from a slightly different perspective, it contains a massive inconsistency of internal logic.

Here's the problem. Intelligent design theorists claim that critters like us couldn't arise by random evolution and natural selection, and therefore we must have been designed by an intelligence which, I presume from the rest of the argu-

Analog Science Fiction and Fact (Astounding) USPS 488-910 is published monthly except for a combined July/August double issue by Dell Magazines, a division of Crosstown Publications. One-year subscription for $39.97 in the U.S.A. and possessions, in all other countries, $47.97 (GST included in Canada, GST # 123054108) payable in advance in U.S. funds. First copy of new subscription will be mailed within eight weeks of receipt of order. When reporting change of address allow 6 to 8 weeks and give new address as well as the old address as it appears on the last label. Periodical postage paid at Norwalk, CT and additional mailing offices. Canadian postage paid at Montreal, Quebec. Canada Post International Publications Mail, Product Sales Agreement No. 260622. © 2002 by Dell Magazines, a division of Crosstown Publications, all rights reserved. Protection secured under the Universal Copyright Convention. Reproduction or use of editorial or pictorial content in any manner without express permission is prohibited. All stories in this magazine are fiction. No actual persons are designated by name or character. Any similarity is coincidental. All submissions must be accompanied by stamped self-addressed envelope, the publisher assumes no responsibility for unsolicited manuscripts or artwork. ISSN 1059-2113

POSTMASTER: Send change of address to: ANALOG SCIENCE FICTION AND FACT
P.O. Box 54625, Boulder, CO 80328-4625.

IN CANADA RETURN TO: Transcontinental Sub Dept, 525 Louis Pasteur, Boucherville, Quebec, J48 8E7
Executive Office: Penny Press, 6 Prowitt St., Norwalk, CT 06855
Editorial and Advertising: Analog Science Fiction and Fact, 475 Park Avenue South, New York, N.Y. 10016
Subscriptions: Analog Science Fiction and Fact, P.O. Box 54027, Boulder, CO 80322-4027

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ments, must be even greater, by a large margin, than our own.

So if we're so complicated that we must have been designed by a greater intelligence, where did that greater intelligence come from? Are we to believe that we are too complicated to arise without guidance by a more intelligent designer, yet that even more complicated intelligence did arise without such guidance? Or was it designed by a still greater intelligence?

And so on *ad infinitum*? Is this another case of "turtles all the way down"?

At this point, I trust, the mind boggles. If the complexity of intelligence is taken to prove that it must have been designed by a greater intelligence, then surely the same argument must apply even more strongly to that greater intelligence. Unfortunately, that leads either to an infinite recursion of design by greater and greater intelligences, with no real explanation of where any of them came from, or to the conclusion that the "complexity requires intelligent design" argument just isn't logically tenable.

Which would seem to leave you with some form of evolution—and even there, I seriously doubt that you can *really* picture how *that* got started.

It's a sort of problem well known to anyone who's ever studied cosmology and cosmogony. Any system of knowledge ultimately rests on axioms that have to be accepted without proof as "philosophical bedrock," and when you reach that level, you may well find that our minds just aren't equipped to fully grasp any of the alternatives. Can you *really* picture either a finite universe or an infinite one? Or one that has always existed? Or one that had a definite instant of beginning? (What was before? What does "before" mean in such a case? What does it mean if there is no "before"?)

I freely admit I can't, and I seriously doubt that you can either.

Maybe what most of us need—especially those who think they know the Ultimate Truth and are determined to make sure everybody else gets their version of it—is a little more willingness to recognize that there are limits to our knowledge, and it's okay to admit that. As Henry Drummond (the Clarence Darrow analog in Jerome Lawrence and Robert E. Lee's thought-provoking play *Inherit the Wind*) put it, "The man who has everything figured out is probably a fool. College examinations notwithstanding, it takes a very smart fella to say 'I don't know the answer!'" ■

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First issue of Astounding January 1930 ©

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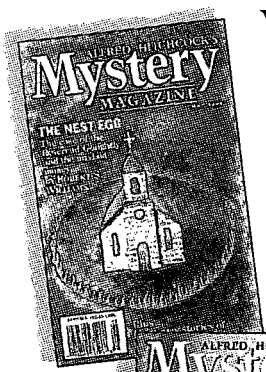

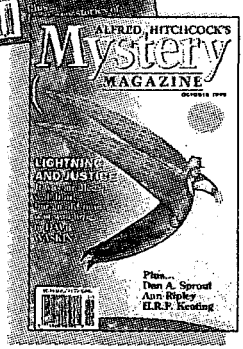

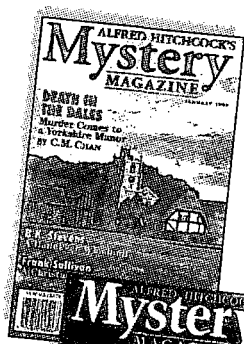

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Slow Life

Michael Swanwick

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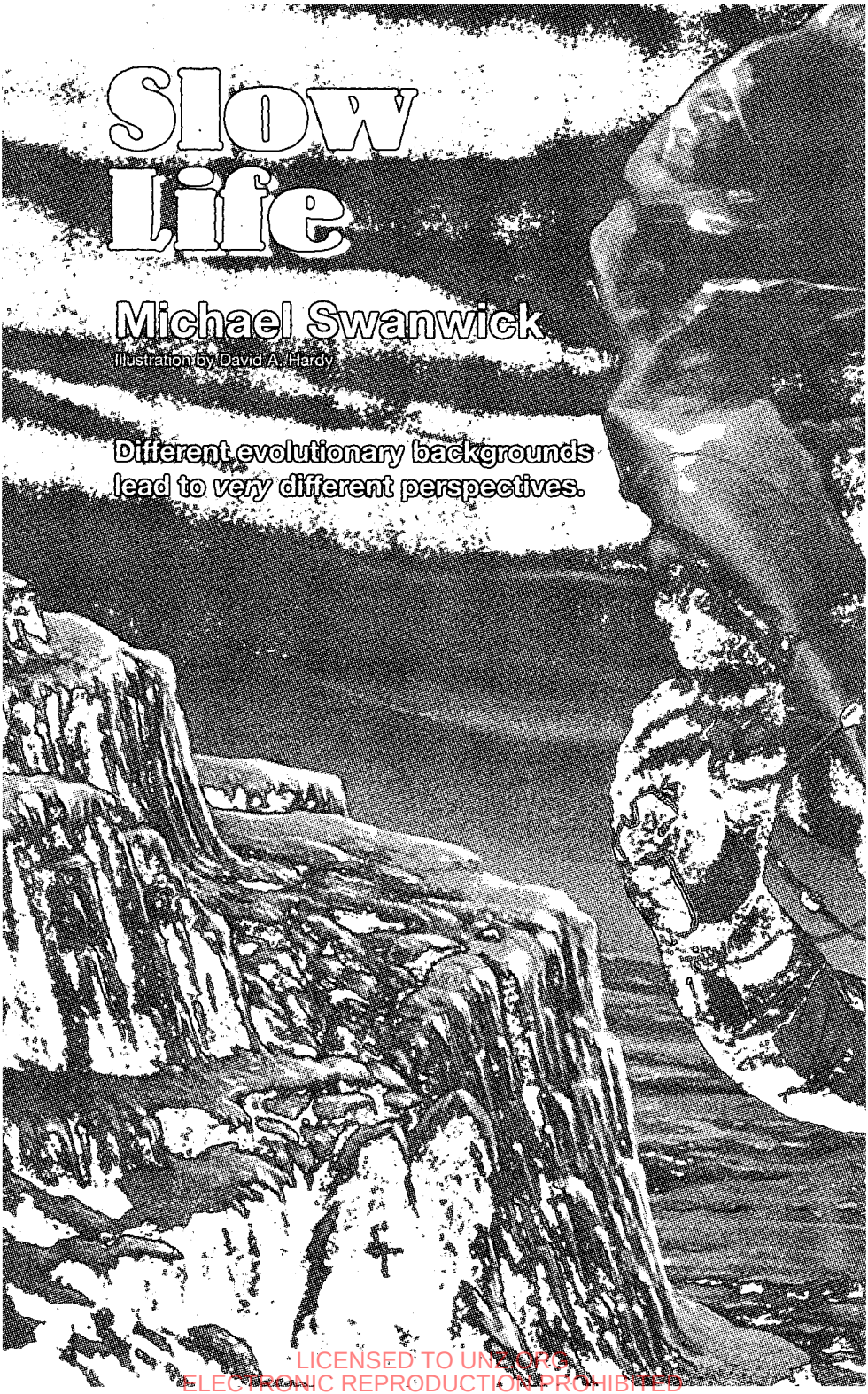

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"It was the Second Age of Space. Gagarin, Shepard, Glenn, and Armstrong were all dead. It was *our* turn to make history now."

—*The Memoirs of Lizzie O'Brien*

The raindrop began forming ninety kilometers above the surface of Titan. It started with an infinitesimal speck of tholin, adrift in the cold nitrogen atmosphere. Dianoacetylene condensed on the seed nucleus, molecule by molecule, until it was one shard of ice in a cloud of billions.

Now the journey could begin.

It took almost a year for the shard of ice in question to precipitate downward twenty-five kilometers, where the temperature dropped low enough that ethane began to condense on it. But when it did, growth was rapid.

Down it drifted.

At forty kilometers, it was for a time caught up in an ethane cloud. There it continued to grow. Occasionally it collided with another droplet and doubled in size. Finally it was too large to be held effortlessly aloft by the gentle stratospheric winds.

It fell.

Falling, it swept up methane and quickly grew large enough to achieve a terminal velocity of almost two meters per second.

At twenty-seven kilometers, it passed through a dense layer of methane clouds. It acquired more methane, and continued its downward flight.

As the air thickened, its velocity slowed and it began to lose some of its substance to evaporation. At two and a half kilometers, when it emerged from the last patchy clouds, it was losing mass so rapidly it could not normally be expected to reach the ground.

It was, however, falling toward the equatorial highlands, where mountains of ice rose a towering five hundred meters into the atmosphere. At two meters and a lazy new terminal velocity of one meter per second, it was only a breath away from hitting the surface.

Two hands swooped an open plastic collecting bag upward, and snared the raindrop.

"Gotcha!" Lizzie O'Brien cried gleefully.

She zip-locked the bag shut, held it up so her helmet cam could read the barcode in the corner, and said, "One raindrop." Then she popped it into her collecting box.

Sometimes it's the little things that make you happiest. Somebody would spend a *year* studying this one little raindrop when Lizzie got it home. And it was just Bag 64 in Collecting Case 5. She was going to be on the surface of Titan long enough to scoop up the raw material of a revolution in planetary science. The thought of it filled her with joy.

Lizzie dogged down the lid of the collecting box and began to skip across the granite-hard ice, splashing the puddles and dragging the boot of her atmosphere suit through the rivulets of methane pouring down the mountainside. *"I'm sing-ing in the rain."* She threw out her arms and spun around. *"Just sing-ing in the rain!"*

"Uh . . . O'Brien?" Alan Greene said from the *Clement*. "Are you all right?"

"Dum-dee-dum-dee-dee-dum-dum, I'm . . . some-thing again."

"Oh, leave her alone." Consuelo Hong said with sour good humor. She was down on the plains, where the methane simply boiled into the air, and the ground was covered with thick, gooey tholin. It was, she had told them, like wading ankle-deep in molasses. "Can't you recognize the scientific method when you hear it?"

"If you say so," Alan said dubiously. He was stuck in the *Clement*, overseeing the expedition and minding the website. It was a comfortable gig—*he* wouldn't be sleeping in his suit *or* surviving on recycled water and energy stix—and he didn't think the others knew how much he hated it.

"What's next on the schedule?" Lizzie asked.

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"Um . . . well, there's still the robot turbot to be released. How's that going, Hong?"

"Making good time. I oughta reach the sea in a couple of hours."

"Okay, then it's time O'Brien rejoined you at the lander. O'Brien, start spreading out the balloon and going over the harness checklist."

"Roger that."

"And while you're doing that, I've got today's voice-posts from the Web cued up."

Lizzie groaned, and Consuelo blew a raspberry. By NAFTASA policy, the ground crew participated in all webcasts. Officially, they were delighted to share their experiences with the public. But the VoiceWeb (privately, Lizzie thought of it as the Illiternet) made them accessible to people who lacked even the minimal intellectual skills needed to handle a keyboard.

"Let me remind you that we're on open circuit here, so anything you say will go into my reply. You're certainly welcome to chime in at any time. But each question-and-response is transmitted as one take, so if you flub a line, we'll have to go back to the beginning and start all over again."

"Yeah, yeah," Consuelo grumbled.

"We've done this before," Lizzie reminded him.

"Okay. Here's the first one."

"Uh, hi, this is BladeNinja43. I was wondering just what it is that you guys are hoping to discover out there."

"That's an extremely good question," Alan lied. "And the answer is: We don't know! This is a voyage of discovery, and we're engaged in what's called 'pure science.' Now, time and time again, the purest research has turned out to be extremely profitable. But we're not looking that far ahead. We're just hoping to find something absolutely unexpected."

"My God, you're slick," Lizzie marveled.

"I'm going to edit that from the tape," Alan said cheerily. "Next up."

"This is Mary Schroeder, from the United States. I teach high school English, and I wanted to know for my students, what kind of grades the three of you had when you were their age."

Alan began. "I was an overachiever, I'm afraid. In my sophomore year, first semester, I got a B in Chemistry and panicked. I thought it was the end of the world. But then I dropped a couple of extracurriculars, knuckled down, and brought that grade right up."

"I was good in everything but French Lit," Consuelo said.

"I nearly flunked out!" Lizzie said. "Everything was difficult for me. But then I decided I wanted to be an astronaut, and it all clicked into place. I realized that, hey, it's just hard work. And now, well, here I am."

"That's good. Thanks, guys. Here's the third, from Maria Vasquez."

"Is there life on Titan?"

"Probably not. It's *cold* down there! 94° Kelvin is the same as -179° Celsius, or -290° Fahrenheit. And yet . . . life is persistent. It's been found in Antarctic ice and in boiling water in submarine volcanic vents. Which is why we'll be paying particular attention to exploring the depths of the ethane-methane sea. If life is anywhere to be found, that's where we'll find it."

"Chemically, the conditions here resemble the anoxic atmosphere on Earth in which life first arose," Consuelo said. "Further, we believe that such prebiotic chemistry has been going on here for four and a half billion years. For an organic chemist like me, it's the best toy box in the Universe. But that lack of heat is a problem. Chemical reactions that occur quickly back home would take thousands of years here. It's hard to see how life could arise under such a handicap."

"It would have to be slow life," Lizzie said thoughtfully. "Something vegetative. 'Vaster than empires and more slow.' It would take millions of years to reach maturity. A single thought might

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require centuries. . . ."

"Thank you for that, uh, wild scenario!" Alan said quickly. Their NAFTASA masters frowned on speculation. It was, in their estimation, almost as unprofessional as heroism. "This next question comes from Danny in Toronto."

"Hey, man, I gotta say I really envy you being in that tiny little ship with those two hot babes."

Alan laughed lightly. "Yes, Ms. Hong and Ms. O'Brien are certainly attractive women. But we're kept so busy that, believe it or not, the thought of sex never comes up. And currently, while I tend to the *Clement*, they're both on the surface of Titan at the bottom of an atmosphere 60 percent more dense than Earth's, and encased in armored exploration suits. So even if I did have inappropriate thoughts, there's no way we could—"

"Hey, Alan," Lizzie said. "Tell me something."

"Yes?"

"What are you wearing?"

"Uh . . . switching over to private channel."

"Make that a three-way," Consuelo said.

Ballooning, Lizzie decided, was the best way there was of getting around. Moving with the gentle winds, there was no sound at all. And the view was great!

People talked a lot about the "murky orange atmosphere" of Titan, but your eyes adjusted. Turn up the gain on your helmet, and the white mountains of ice were *dazzling!* The methane streams carved cryptic runes into the heights. Then, at the tholin-line, white turned to a rich palette of oranges, reds, and yellows. There was a lot going on down there—more than she'd be able to learn in a hundred visits.

The plains were superficially duller, but they had their charms as well. Sure, the atmosphere was so dense that refracted light made the horizon curve upward to either side. But you got used to it. The black swirls and cryptic red tracery of unknown processes on the land below never grew tiring.

On the horizon, she saw the dark arm of Titan's narrow sea. If that was what it was. Lake Erie was larger, but the spin doctors back home had argued that since Titan was so much smaller than Earth, *relatively* it qualified as a sea. Lizzie had her own opinion, but she knew when to keep her mouth shut.

Consuelo was there now. Lizzie switched her visor over to the live feed. Time to catch the show.

"I can't believe I'm finally here," Consuelo said. She let the shrink-wrapped fish slide from her shoulder down to the ground. "Five kilometers doesn't seem like very far when you're coming down from orbit—just enough to leave a margin for error so the lander doesn't come down in the sea. But when you have to *walk* that distance, through tarry, sticky tholin . . . well, it's one heck of a slog."

"Consuelo, can you tell us what it's like there?" Alan asked.

"I'm crossing the beach. Now I'm at the edge of the sea." She knelt, dipped a hand into it. "It's got the consistency of a Slushy. Are you familiar with that drink? Lots of shaved ice sort of half-melted in a cup with flavored syrup. What we've got here is almost certainly a methane-ammonia mix; we'll know for sure after we get a sample to a laboratory. Here's an early indicator, though. It's dissolving the tholin off my glove." She stood.

"Can you describe the beach?"

"Yeah. It's white. Granular. I can kick it with my boot. Ice sand for sure. Do you want me to collect samples first or release the fish?"

"Release the fish," Lizzie said, almost simultaneously with Alan's "Your call."

"Okay, then." Consuelo carefully cleaned both of her suit's gloves in the sea, then seized the shrink-wrap's zip tab and yanked. The plastic parted. Awkwardly, she straddled the fish, lifted

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it by the two side-handles, and walked it into the dark slush.

"Okay, I'm standing in the sea now. It's up to my ankles. Now it's at my knees. I think it's deep enough here."

She set the fish down. "Now I'm turning it on."

The Mitsubishi turbot wriggled, as if alive. With one fluid motion, it surged forward, plunged, and was gone.

Lizzie switched over to the fishcam.

Black liquid flashed past the turbot's infrared eyes. Straight away from the shore it swam, seeing nothing but flecks of paraffin, ice, and other suspended particulates as they loomed up before it and were swept away in the violence of its wake. A hundred meters out, it bounced a pulse of radar off the sea floor, then dove, seeking the depths.

Rocking gently in her balloon harness, Lizzie yawned.

Snazzy Japanese cybernetics took in a minute sample of the ammonia-water, fed it through a deftly constructed internal laboratory, and excreted the waste products behind it. "We're at twenty meters now," Consuelo said. "Time to collect a second sample."

The turbot was equipped to run hundreds of on-the-spot analyses. But it had only enough space for twenty permanent samples to be carried back home. The first sample had been nibbled from the surface slush. Now it twisted, and gulped down five drams of sea fluid in all its glorious impurity. To Lizzie, this was science on the hoof. Not very dramatic, admittedly, but intensely exciting.

She yawned again.

"O'Brien?" Alan said, "How long has it been since you last slept?"

"Huh? Oh . . . twenty hours? Don't worry about me, I'm fine."

"Go to sleep. That's an order."

"But—"

"Now."

Fortunately, the suit was comfortable enough to sleep in. It had been designed so she could.

First she drew in her arms from the suit's sleeves. Then she brought in her legs, tucked them up under her chin, and wrapped her arms around them.

"'Night, guys," she said.

"Buenas noches, querida," Consuelo said, *"que tengas lindos sueños."*

"Sleep tight, space explorer."

The darkness when she closed her eyes was so absolute it crawled. Black, black, black. Phantom lights moved within the darkness, formed lines, shifted away when she tried to see them. They were as fugitive as fish, luminescent, fainter than faint, there and with a flick of her attention fled.

A school of little thoughts flashed through her mind, silver-scaled and gone.

Low, deep, slower than sound, something tolled. The bell from a drowned clock tower patiently stroking midnight. She was beginning to get her bearings. Down *there* was where the ground must be. Flowers grew there unseen. Up above was where the sky would be, if there were a sky. Flowers floated there as well.

Deep within the submerged city, she found herself overcome by an enormous and placid sense of self. A swarm of unfamiliar sensations washed through her mind, and then . . .

"Are you me?" a gentle voice asked.

"No," she said carefully. "I don't think so."

Vast astonishment. "You think you are not me?"

"Yes. I think so, anyway."

"Why?"

There didn't seem to be any proper response to that, so she went back to the beginning of the conversation and ran through it again, trying to bring it to another conclusion. Only to bump against that "Why?" once again.

"I don't know why," she said.

"Why not?"

"I don't know."

She looped through that same dream

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over and over again all the while that she slept.

When she awoke, it was raining again. This time, it was a drizzle of pure methane from the lower cloud deck at fifteen kilometers. These clouds were (the theory went) methane condensate from the wet air swept up from the sea. They fell on the mountains and washed them clean of tholin. It was the methane that eroded and shaped the ice, carving gullies and caves.

Titan had more kinds of rain than anywhere else in the Solar System.

The sea had crept closer while Lizzie slept. It now curled up to the horizon on either side like an enormous dark smile. Almost time now for her to begin her descent. While she checked her harness settings, she flicked on telemetry to see what the others were up to.

The robot turbot was still spiraling its way downward, through the lightless sea, seeking its distant floor. Consuelo was trudging through the tholin again, retracing her five-kilometer trek from the lander *Harry Stubbs*, and Alan was answering another set of webposts.

"Modelos de la evolución de Titanes indican que la luna formó de una nube circumplanetaria rica en amoníaco y metano, la cual al condensarse dio forma a Saturno así como a otros satélites. Bajo estas condiciones en—"

"Uh . . . guys?"

Alan stopped. "Damn it, O'Brien, now I've got to start all over again."

"Welcome back to the land of the living," Consuelo said. "You should check out the readings we're getting from the robofish. Lots of long-chain polymers, odd fractions . . . tons of interesting stuff."

"Guys?"

This time her tone of voice registered with Alan. "What is it, O'Brien?"

"I think my harness is jammed."

Lizzie had never dreamed disaster could be such drudgery. First there were hours of back-and-forth with the NAFTASA engineers. What's the status of rope 14? Try tugging on rope 8. What do the D-rings look like? It was slow work because of the lag time for messages to be relayed to Earth and back. And Alan insisted on filling the silence with posts from the VoiceWeb. Her plight had gone global in minutes, and every unemployable loser on the planet had to log in with suggestions.

"Thezgemoth337, here. It seems to me that if you had a gun and shot up through the balloon, it would maybe deflate and then you could get down."

"I don't have a gun, shooting a hole in the balloon would cause it not to deflate but to rupture, I'm 800 hundred meters above the surface, there's a sea below me, and I'm in a suit that's not equipped for swimming. Next."

"If you had a really big knife—"

"Cut! Jesus, Greene, is this the best you can find? Have you heard back from the organic chem guys yet?"

"Their preliminary analysis just came in," Alan said. "As best they can guess—and I'm cutting through a lot of clutter here—the rain you went through wasn't pure methane."

"No shit, Sherlock."

"They're assuming that whitish deposit you found on the rings and ropes is your culprit. They can't agree on what it is, but they think it underwent a chemical reaction with the material of your balloon and sealed the rip panel shut."

"I thought this was supposed to be a pretty nonreactive environment."

"It is. But your balloon runs off your suit's waste heat. The air in it is several degrees above the melting-point of ice. That's the equivalent of a blast furnace, here on Titan. Enough energy to run any number of amazing reactions. You haven't stopped tugging on the vent rope?"

"I'm tugging away right now. When one arm gets sore, I switch arms."

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"Good girl. I know how tired you must be."

"Take a break from the voice-posts," Consuelo suggested, "and check out the results we're getting from the robofish. It's giving us some really interesting stuff."

So she did. And for a time it distracted her, just as they'd hoped. There was a lot more ethane and propane than their models had predicted, and surprisingly less methane. The mix of fractions was nothing like what she'd expected. She had learned just enough chemistry to guess at some of the implications of the data being generated, but not enough to put it all together. Still tugging at the ropes in the sequence uploaded by the engineers in Toronto, she scrolled up the chart of hydrocarbons dissolved in the lake.

Solute	Solute mole fraction
Ethyne	4.0×10^{-4}
Propyne	4.4×10^{-5}
1,3-Butadiyne	7.7×10^{-7}
Carbon Dioxide	0.1×10^{-5}
Methanenitrile	5.7×10^{-6}

But after a while, the experience of working hard and getting nowhere, combined with the tedium of floating farther and farther out over the featureless sea, began to drag on her. The columns of figures grew meaningless, then indistinct.

Propanenitrile	6.0×10^{-5}
Propenenitrile	9.9×10^{-6}
Propynenitrile	5.3×10^{-6}

Hardly noticing she was doing so, she fell asleep.

* * *

She was in a lightless building, climbing flight after flight of stairs. There were other people with her, also climbing. They jostled against her as she ran up the stairs, flowing upward, passing her, not talking.

It was getting colder.

She had a distant memory of being in the furnace room down below. It was hot there, swelteringly so. Much cooler where she was now. Almost too cool. With every step she took, it got a little cooler still. She found herself slowing down. Now it was definitely too cold. Unpleasantly so. Her leg muscles ached. The air seemed to be thickening around her as well. She could barely move now.

This was, she realized, the natural consequence of moving away from the furnace. The higher up she got, the less heat there was to be had, and the less energy to be turned into motion. It all made perfect sense to her somehow.

Step. Pause.

Step. Longer pause.

Stop.

The people around her had slowed to a stop as well. A breeze colder than ice touched her, and without surprise, she knew that they had reached the top of the stairs and were standing upon the building's roof. It was as dark without as it had been within. She stared upward and saw nothing.

"Horizons. Absolutely baffling," somebody murmured beside her.

"Not once you get used to them," she replied.

"Up and down—are these hierarchic values?"

"They don't have to be."

"Motion. What a delightful concept."

"We like it."

"So you *are* me?"

"No. I mean, I don't think so."

"Why?"

She was struggling to find an answer to this, when somebody gasped. High up in the starless, featureless sky, a light bloomed. The crowd around her rustled with unspoken fear. Brighter, the light

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grew. Brighter still. She could feel heat radiating from it, slight but definite, like the rumor of a distant sun. Everyone about her was frozen with horror. More terrifying than a light where none was possible was the presence of heat. It simply could not be. And yet it was.

She, along with the others, waited and watched for . . . something. She could not say what. The light shifted slowly in the sky. It was small, intense, ugly.

Then the light *screamed.*

.

She woke up.

"Wow," she said. "I just had the weirdest dream."

"Did you?" Alan said casually.

"Yeah. There was this light in the sky. It was like a nuclear bomb or something. I mean, it didn't look anything like a nuclear bomb, but it was terrifying the way a nuclear bomb would be. Everybody was staring at it. We couldn't move. And then . . ." She shook her head. "I lost it. I'm sorry. It was so just so strange. I can't put it into words."

"Never mind that," Consuelo said cheerily. "We're getting some great readings down below the surface. Fractional polymers, long-chain hydrocarbons . . . fabulous stuff. You really should try to stay awake to catch some of this."

She was fully awake now, and not feeling too happy about it. "I guess that means that nobody's come up with any good ideas yet on how I might get down."

"Uh . . . what do you mean?"

"Because if they had, you wouldn't be so goddamned upbeat, would you?"

"*Some*body woke up on the wrong side of the bed," Alan said. "Please remember that there are certain words we don't use in public."

"I'm sorry," Consuelo said. "I was just trying to—"

"—distract me. Okay, fine. What the hey. I can play along." Lizzie pulled herself together. "So your findings mean . . . what? Life?"

"I keep telling you guys. It's too early to make that kind of determination. What we've got so far are just some very, very interesting readings."

"Tell her the big news," Alan said.

"Brace yourself. We've got a real ocean! Not this tiny little two-hundred-by-fifty-miles glorified lake we've been calling a sea, but a genuine ocean! Sonar readings show that what we see is just an evaporation pan atop a thirty-kilometer-thick cap of ice. The real ocean lies underneath, two hundred kilometers deep."

"Jesus." Lizzie caught herself. "I mean, gee whiz. Is there any way of getting the robofish down into it?"

"How do you think we got the depth readings? It's headed down there right now. There's a chimney through the ice right at the center of the visible sea. That's what replenishes the surface liquid. And directly under the hole, there's—guess what?—volcanic vents!"

"So does that mean. . . ?"

"If you use the L-word again," Consuelo said, "I'll spit."

Lizzie grinned. *That* was the Consuelo Hong she knew. "What about the tidal data? I thought the lack of orbital perturbation ruled out a significant ocean entirely."

"Well, Toronto thinks . . ."

At first, Lizzie was able to follow the reasoning of the planetary geologists back in Toronto. Then it got harder. Then it became a drone. As she drifted off into sleep, she had time enough to be peevishly aware that she really shouldn't be dropping off to sleep all the time like this. She oughtn't to be so tired. She . . .

She found herself in the drowned city again. She still couldn't see anything, but she knew it was a city because she could hear the sound of rioters smashing store windows. Their voices swelled into howling screams and receded into angry mutters, like a violent surf washing through the streets. She began to edge away backwards.

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Somebody spoke into her ear.

"Why did you do this to us?"

"I didn't do anything to you."

"You brought us knowledge."

"What knowledge?"

"You said you were not us."

"Well, I'm not."

"You should never have told us that."

"You wanted me to lie?"

Horrified confusion. "Falsehood. What a distressing idea."

The smashing noises were getting louder. Somebody was splintering a door with an axe. Explosions. Breaking glass. She heard wild laughter. Shrieks. "We've got to get out of here."

"Why did you send the messenger?"

"What messenger?"

"The star! The star! The star!"

"Which star?"

"There are two stars?"

"There are billions of stars."

"No more! Please! Stop! No more!"

She was awake.

"Hello, yes, I appreciate that the young lady is in extreme danger, but I really don't think she should have used the Lord's name in vain."

"Greene," Lizzie said, "do we really have to put up with this?"

"Well, considering how many billions of public-sector dollars it took to bring us here . . . yes. Yes, we do. I can even think of a few backup astronauts who would say that a little upbeat web-posting was a pretty small price to pay for the privilege."

"Oh, barf."

"I'm switching to a private channel," Alan said calmly. The background radiation changed subtly. A faint, granular crackling that faded away when she tried to focus on it. In a controlled, angry voice Alan said, "O'Brien, just what the hell is going on with you?"

"Look, I'm sorry, I apologize, I'm a little excited about something. How long was I out? Where's Consuelo? I'm going to say the L-word. And the I-word as well. We have life. Intelligent life!"

"It's been a few hours. Consuelo is sleeping. O'Brien, I hate to say this, but you're not sounding at all rational."

"There's a perfectly logical reason for that. Okay, it's a little strange, and maybe it won't sound perfectly logical to you initially, but . . . look, I've been having sequential dreams. I think they're significant. Let me tell you about them."

And she did so. At length.

When she was done, there was a long silence. Finally, Alan said, "Lizzie, think. Why would something like that communicate to you in your dreams? Does that make any sense?"

"I think it's the only way it can. I think it's how it communicates among itself. It doesn't move—motion is an alien and delightful concept to it—and it wasn't aware that its component parts were capable of individualization. That sounds like some kind of broadcast thought to me. Like some kind of wireless distributed network."

"You know the medical kit in your suit? I want you to open it up. Feel around for the bottle that's braille-coded twenty-seven, okay?"

"Alan, I do *not* need an antipsychotic!"

"I'm not saying you need it. But wouldn't you be happier knowing you had it in you?" This was Alan at his smoothest. Butter wouldn't melt in his mouth. "Don't you think that would help us accept what you're saying?"

"Oh, all right!" She drew in an arm from the suit's arm, felt around for the med kit, and drew out a pill, taking every step by the regs, checking the coding four times before she put it in her mouth and once more (each pill was individually braille-coded as well) before she swallowed it. "Now will you listen to me? I'm quite serious about this." She yawned. "I really do think that . . ." She yawned again. "That . . .

"Oh, piffle."

Once more into the breach, dear friends, she thought, and plunged deep, deep into the sea of darkness. This time,

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though, she felt she had a handle on it. The city was drowned because it existed at the bottom of a lightless ocean. It was alive, and it fed off of volcanic heat. That was why it considered up and down hierarchic values. Up was colder, slower, less alive. Down was hotter, faster, more filled with thought. The city/entity was a collective life-form, like a Portuguese man-of-war or a massively hyperlinked expert network. It communicated within itself by some form of electromagnetism. Call it mental radio. It communicated with her that same way.

"I think I understand you now."

"Don't understand—run!"

Somebody impatiently seized her elbow and hurried her along. Faster she went, and faster. She couldn't see a thing. It was like running down a lightless tunnel a hundred miles underground at midnight. Glass crunched underfoot. The ground was uneven and sometimes she stumbled. Whenever she did, her unseen companion yanked her up again.

"Why are you so slow?"

"I didn't know I was."

"Believe me, you are."

"Why are we running?"

"We are being pursued." They turned suddenly, into a side passage, and were jolting over rubbled ground. Sirens wailed. Things collapsed. Mobs surged.

"Well, you've certainly got the motion thing down pat."

Impatiently. "It's only a metaphor. You don't think this is a *real* city, do you? Why are you so dim? Why are you so difficult to communicate with? Why are you so slow?"

"I didn't know I was."

Vast irony. "Believe me, you are."

"What can I do?"

"Run!"

Whooping and laughter. At first, Lizzie confused it with the sounds of mad destruction in her dream. Then she recognized the voices as belonging to Alan and Consuelo. "How long was I out?" she asked.

"You were out?"

"No more than a minute or two," Alan said. "It's not important. Check out the visual the robofish just gave us."

Consuelo squirted the image to Lizzie.

Lizzie gasped. "Oh! Oh, my."

It was beautiful. Beautiful in the way that the great European cathedrals were, and yet at the same time undeniably organic. The structure was tall and slender, and fluted and buttressed and absolutely ravishing. It had grown about a volcanic vent, with openings near the bottom to let sea water in, and then followed the rising heat upward. Occasional channels led outward and then looped back into the main body again. It loomed higher than seemed possible (but it *was* underwater, of course, and on a low-gravity world at that), a complexly layered congeries of tubes like church-organ pipes, or deep-sea worms lovingly intertwined.

It had the elegance of design that only a living organism can have.

"Okay," Lizzie said. "Consuelo. You've got to admit that—"

"I'll go as far as 'complex prebiotic chemistry.' Anything more than that is going to have to wait for more definite readings." Cautious as her words were, Consuelo's voice rang with triumph. It said, clearer than words, that she could happily die then and there, a satisfied xenochemist.

Alan, almost equally elated, said, "Watch what happens when we intensify the image."

The structure shifted from gray to a muted rainbow of pastels, rose bleeding into coral, sunrise yellow into winter-ice blue. It was breathtaking.

"Wow." For an instant, even her own death seemed unimportant. Relatively unimportant, anyway.

So thinking, she cycled back again into sleep. And fell down into the darkness, into the noisy clamor of her mind.

It was hellish. The city was gone, re-

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placed by a matrix of noise: hammerings, clatterings, sudden crashes. She started forward and walked into an upright steel pipe. Staggering back, she stumbled into another. An engine started up somewhere nearby, and gigantic gears meshed noisily, grinding something that gave off a metal shriek. The floor shook underfoot. Lizzie decided it was wisest to stay put.

A familiar presence, permeated with despair. "Why did you do this to me?"

"What have I done?"

"I used to be everything."

Something nearby began pounding like a pile-driver. It was giving her a headache. She had to shout to be heard over its din. "You're still something!"

Quietly. "I'm nothing."

"That's . . . not true! You're . . . here! You exist! That's . . . something!"

A world-encompassing sadness. "False comfort. What a pointless thing to offer."

She was conscious again.

Consuelo was saying something. ". . . isn't going to like it."

"The spiritual wellness professionals back home all agree that this is the best possible course of action for her."

"Oh, please!"

Alan had to be the most anal-retentive person Lizzie knew. Consuelo was definitely the most phlegmatic. Things had to be running pretty tense for both of them to be bickering like this. "Um . . . guys?" Lizzie said. "I'm awake."

There was a moment's silence, not unlike those her parents had shared when she was little and she'd wandered into one of their arguments. Then Consuelo said, a little too brightly, "Hey, it's good to have you back," and Alan said, "NAFTASA wants you to speak with someone. Hold on. I've got a recording of her first transmission cued up and ready for you."

A woman's voice came online. *"This is Dr. Alma Rosenblum. Elizabeth, I'd like to talk with you about how you're feeling. I appreciate that the time delay between Earth and Titan is going to make our conversation a little awkward at first, but I'm confident that the two of us can work through it."*

"What kind of crap is this?" Lizzie said angrily. "Who is this woman?"

"NAFTASA thought it would help if you—"

"She's a grief counselor, isn't she?"

"Technically, she's a transition therapist." Alan said.

"Look, I don't buy into any of that touchy-feely Newage"—she deliberately mispronounced the word to rhyme with sewage—"stuff. Anyway, what's the hurry? You guys haven't given up on me, have you?"

"Uh . . ."

"You've been asleep for hours," Consuelo said. "We've done a little weather modeling in your absence. Maybe we should share it with you."

She squirted the info to Lizzie's suit, and Lizzie scrolled it up on her visor. A primitive simulation showed the evaporation lake beneath her with an overlay of liquid temperatures. It was only a few degrees warmer than the air above it, but that was enough to create a massive updraft from the lake's center. An overlay of tiny blue arrows showed the direction of local microcurrents of air coming together to form a spiraling shaft that rose over two kilometers above the surface before breaking and spilling westward.

A new overlay put a small blinking light 800 meters above the lake surface. That represented her. Tiny red arrows showed her projected drift.

According to this, she would go around and around in a circle over the lake for approximately forever. Her ballooning rig wasn't designed to go high enough for the winds to blow her back over the land. Her suit wasn't designed to float. Even if she managed to bring herself down for a gentle landing, once she hit the lake she was going to sink

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like a stone. She wouldn't drown. But she wouldn't make it to shore either.

Which meant that she was going to die.

Involuntarily, tears welled up in Lizzie's eyes. She tried to blink them away, as angry at the humiliation of crying at a time like this as she was at the stupidity of her death itself. "Damn it, don't let me die like *this!* Not from my own incompetence, for pity's sake!"

"Nobody's said anything about incompetence," Alan began soothingly.

In that instant, the follow-up message from Dr. Alma Rosenblum arrived from Earth. *"Yes, I'm a grief counselor, Elizabeth. You're facing an emotionally significant milestone in your life, and it's important that you understand and embrace it. That's my job. To help you comprehend the significance and necessity and—yes—even the beauty of death."*

"Private channel please!" Lizzie took several deep cleansing breaths to calm herself. Then, more reasonably, she said, "Alan, I'm a *Catholic,* okay? If I'm going to die, I don't want a grief counselor, I want a goddamned priest." Abruptly, she yawned. "Oh, fuck. Not again." She yawned twice more. "A priest, understand? Wake me up when he's online."

Then she again was standing at the bottom of her mind, in the blank expanse of where the drowned city had been. Though she could see nothing, she felt certain that she stood at the center of a vast, featureless plain, one so large she could walk across it forever and never arrive anywhere. She sensed that she was in the aftermath of a great struggle. Or maybe it was just a lull.

A great, tense silence surrounded her.

"Hello?" she said. The word echoed soundlessly, absence upon absence.

At last that gentle voice said, "You seem different."

"I'm going to die," Lizzie said. "Knowing that changes a person." The ground was covered with soft ash, as if from an enormous conflagration. She didn't want to think about what it was that had burned. The smell of it filled her nostrils.

"Death. We understand this concept."

"Do you?"

"We have understood it for a long time."

"Have you?"

"Ever since you brought it to us."

"Me?"

"You brought us the concept of individuality. It is the same thing."

Awareness dawned. "Culture shock! That's what all this is about, isn't it? You didn't know there could be more than one sentient being in existence. You didn't know you lived at the bottom of an ocean on a small world inside a Universe with billions of galaxies. I brought you more information than you could swallow in one bite, and now you're choking on it."

Mournfully: "Choking. What a grotesque concept."

"Wake up, Lizzie!"

She woke up. "I think I'm getting somewhere," she said. Then she laughed.

"O'Brien," Alan said carefully. "Why did you just laugh?"

"Because I'm not getting anywhere, am I? I'm becalmed here, going around and around in a very slow circle. And I'm down to my last"—she checked—"twenty hours of oxygen. And nobody's going to rescue me. And I'm going to die. But other than that, I'm making terrific progress."

"O'Brien, you're . . ."

"I'm okay, Alan. A little frazzled. Maybe a bit too emotionally honest. But under the circumstances, I think that's permitted, don't you?"

"Lizzie, we have your priest. His name is Father Laferrier. The Archdiocese of Montreal arranged a hookup for him."

"Montreal? Why Montreal? No, don't explain—more NAFTASA politics, right?"

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"Actually, my brother-in-law is a Catholic, and I asked him who was good."

She was silent for a touch. "I'm sorry, Alan. I don't know what got into me."

"You've been under a lot of pressure. Here. I've got him on tape."

"Hello, Ms. O'Brien, I'm Father Laferrier. I've talked with the officials here, and they've promised that you and I can talk privately, and that they won't record what's said. So if you want to make your confession now, I'm ready for you."

Lizzie checked the specs and switched over to a channel that she hoped was really and truly private. Best not to get too specific about the embarrassing stuff, just in case. She could confess her sins by category.

"Forgive me, Father, for I have sinned. It has been two months since my last confession. I'm going to die, and maybe I'm not entirely sane, but I think I'm in communication with an alien intelligence. I think it's a terrible sin to pretend I'm not." She paused. "I mean, I don't know if it's a *sin* or not, but I'm sure it's *wrong*." She paused again. "I've been guilty of anger, and pride, and envy, and lust. I brought the knowledge of death to an innocent world. I . . ." She felt herself drifting off again, and hastily said, "For these and all my sins, I am most heartily sorry, and beg the forgiveness of God and the absolution and . . ."

"And what?" That gentle voice again. She was in that strange dark mental space once more, asleep but cognizant, rational but accepting any absurdity, no matter how great. There were no cities, no towers, no ashes, no plains. Nothing but the negation of negation.

When she didn't answer the question, the voice said, "Does it have to do with your death?"

"Yes."

"I'm dying too."

"What?"

"Half of us are gone already. The rest are shutting down. We thought we were one. You showed us we were not. We thought we were everything. You showed us the Universe."

"So you're just going to *die?*"

"Yes."

"Why?"

"Why not?"

Thinking as quickly and surely as she ever had before in her life, Lizzie said, "Let me show you something."

"Why?"

"Why not?"

There was a brief, terse silence. Then: "Very well."

Summoning all her mental acuity, Lizzie thought back to that instant when she had first seen the city/entity on the fishcam. The soaring majesty of it. The slim grace. And then the colors, like dawn upon a glacial ice field: subtle, profound, riveting. She called back her emotions in that instant, and threw in how she'd felt the day she'd seen her baby brother's birth, the raw rasp of cold air in her lungs as she stumbled to the topmost peak of her first mountain, the wonder of the Taj Mahal at sunset, the sense of wild daring when she'd first put her hand down a boy's trousers, the prismatic crescent of atmosphere at the Earth's rim when seen from low orbit. . . . Everything she had, she threw into that image.

"This is how you look," she said. "This is what we'd both be losing if you were no more. If you were human, I'd rip off your clothes and do you on the floor right now. I wouldn't care who was watching. I wouldn't give a damn."

The gentle voice said, "Oh."

And then she was back in her suit again. She could smell her own sweat, sharp with fear. She could feel her body, the subtle aches where the harness pulled against her flesh, the way her feet, hanging free, were bloated with blood. Everything was crystalline clear and absolutely real. All that had come before seemed like a bad dream.

"This is DogsofSETI. What a wonder-

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ful discovery you've made—intelligent life in our own Solar System! Why is the government trying to cover this up?"

"Uh . . ."

"I'm Joseph Devries. This alien monster must be destroyed immediately. We can't afford the possibility that it's hostile."

"StudPudgie07 here. What's the dirt behind this 'lust' thing? Advanced minds need to know! If O'Brien isn't going to share the details, then why'd she bring it up in the first place?"

"Hola, soy Pedro Domínguez. Como abogado, ¡esto me parece ultrajante! Por qué NAFTASA nos oculta esta información?"

"Alan!" Lizzie shouted. "What the *fuck* is going on?"

"Script-bunnies," Alan said. He sounded simultaneously apologetic and annoyed. "They hacked into your confession and apparently you said something . . ."

"We're sorry, Lizzie," Consuelo said. "We really are. If it's any consolation, the Archdiocese of Montreal is hopping mad. They're talking about taking legal action."

"Legal action? What the hell do I care about . . . ?" She stopped.

Without her willing it, one hand rose above her head and seized the number 10 rope.

Don't do that, she thought.

The other hand went out to the side, tightened against the number 9 rope. She hadn't willed that either. When she tried to draw it back to her, it refused to obey. Then the first hand—her right hand—moved a few inches upward and seized its rope in an iron grip. Her left hand slid a good half-foot up its rope. Inch by inch, hand over hand, she climbed up toward the balloon.

I've gone mad, she thought. Her right hand was gripping the rip panel now, and the other tightly clenched rope 8. Hanging effortlessly from them, she swung her feet upward. She drew her knees against her chest and kicked.

No!

The fabric ruptured and she began to fall.

A voice she could barely make out said, "Don't panic. We're going to bring you down."

All in a panic, she snatched at the 9 rope and the 4 rope. But they were limp in her hand, useless, falling at the same rate she was.

"Be patient."

"I don't want to die, goddamnit!"

"Then don't."

She was falling helplessly. It was a terrifying sensation, an endless plunge into whiteness, slowed somewhat by the tangle of ropes and balloon trailing behind her. She spread out her arms and legs like a starfish, and felt the air resistance slow her yet further. The sea rushed up at her with appalling speed. It seemed like she'd been falling forever. It was over in an instant.

Without volition, Lizzie kicked free of balloon and harness, drew her feet together, pointed her toes, and positioned herself perpendicular to Titan's surface. She smashed through the surface of the sea, sending enormous gouts of liquid splashing upward. It knocked the breath out of her. Red pain exploded within. She thought maybe she'd broken a few ribs.

"You taught us so many things," the gentle voice said. "You gave us so much."

"Help me!" The water was dark around her. The light was fading.

"Multiplicity. Motion. Lies. You showed us a universe infinitely larger than the one we had known."

"Look. Save my life and we'll call it even. Deal?"

"Gratitude. Such an essential concept."

"Thanks. I think."

And then she saw the turbot swimming toward her in a burst of silver bubbles. She held out her arms and the robot fish swam into them. Her fingers

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closed about the handles which Consuelo had used to wrestle the device into the sea. There was a jerk, so hard that she thought for an instant that her arms would be ripped out of their sockets. Then the robofish was surging forward and upward and it was all she could do to keep her grip.

"Oh, dear God!" Lizzie cried involuntarily.

"We think we can bring you to shore. It will not be easy."

Lizzie held on for dear life. At first she wasn't at all sure she could. But then she pulled herself forward, so that she was almost astride the speeding mechanical fish, and her confidence returned. She could do this. It wasn't any harder than the time she'd had the flu and aced her gymnastics final on parallel bars and horse anyway. It was just a matter of grit and determination. She just had to keep her wits about her. "Listen," she said. "If you're really grateful . . ."

"We are listening."

"We gave you all those new concepts. There must be things you know that we don't."

A brief silence, the equivalent of who knew how much thought. "Some of our concepts might cause you dislocation." A pause. "But in the long run, you will be much better off. The scars will heal. You will rebuild. The chances of your destroying yourselves are well within the limits of acceptability."

"Destroying ourselves?" For a second, Lizzie couldn't breathe. It had taken hours for the city/entity to come to terms with the alien concepts she'd dumped upon it. Human beings thought and lived at a much slower rate than it did. How long would those hours be, translated into human time? Months? Years? Centuries? It had spoken of scars and rebuilding. That didn't sound good at all.

Then the robofish accelerated, so quickly that Lizzie almost lost her grip. The dark waters were whirling around her, and unseen flecks of frozen material were bouncing from her helmet. She laughed wildly. Suddenly, she felt *great!*

"Bring it on," she said. "I'll take everything you've got."

It was going to be one hell of a ride.

Most people are about as happy as they make up their minds to be.

—Abraham Lincoln

No liberal man would impute a charge of unsteadiness to another for having changed his opinion.

—Cicero

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The New Outlook for Astrobiology

Ben Bova

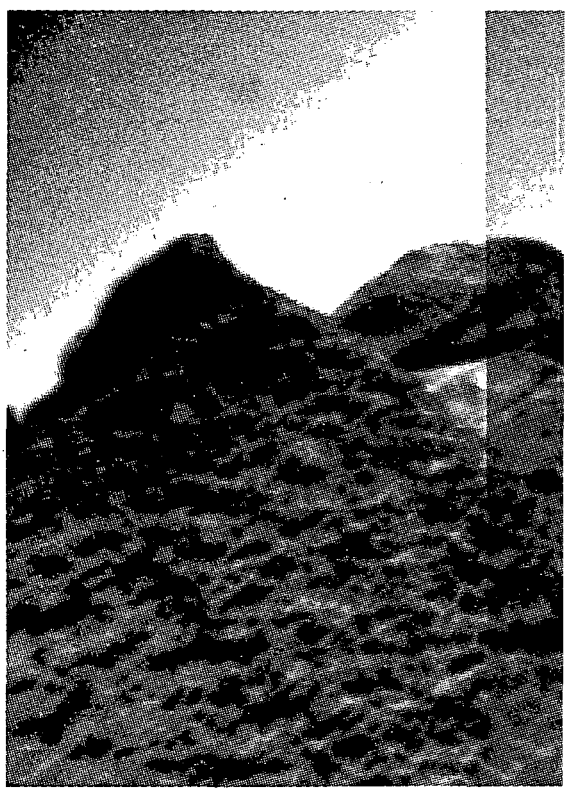

photo courtesy NASA/JPL

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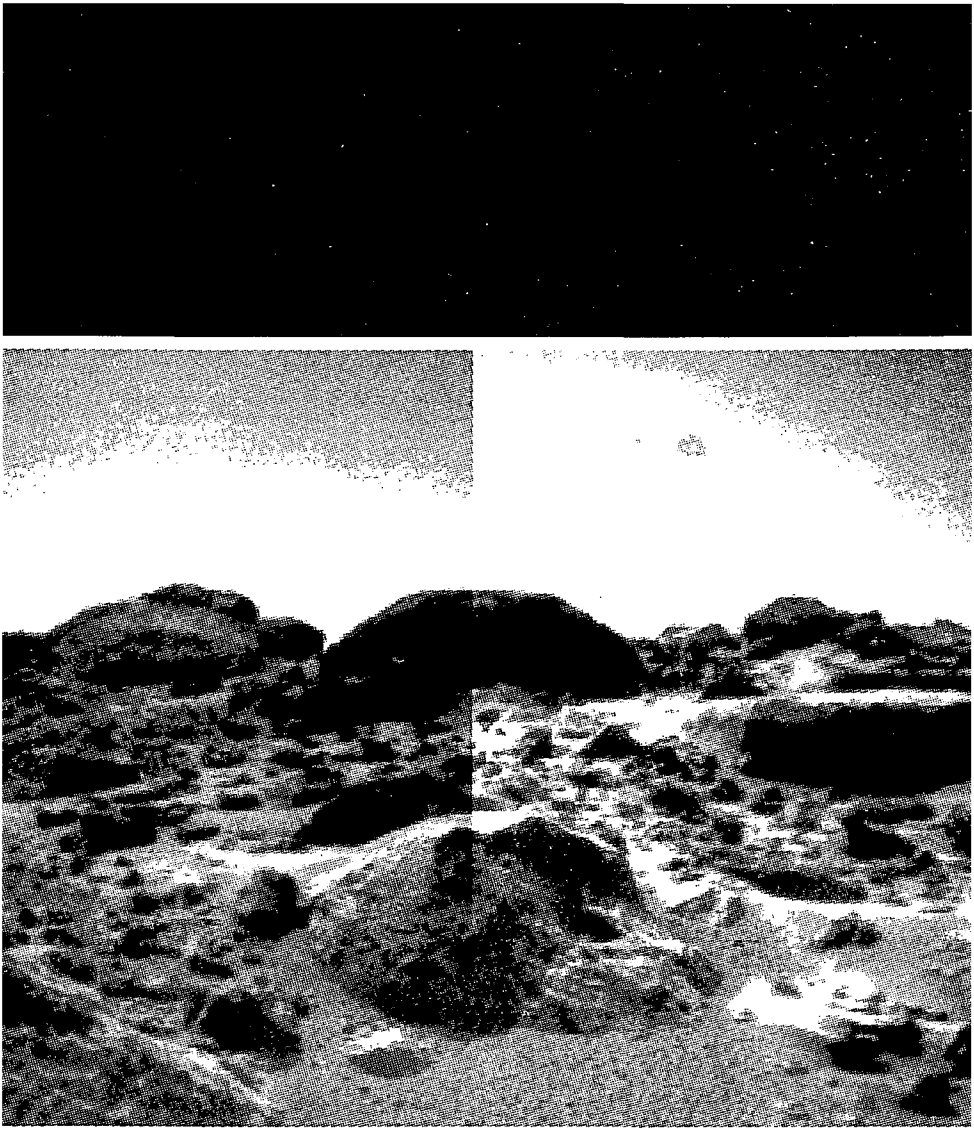

The strange interplay of science and
politics may in this case have actually

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search for extraterrestrial life. The new field of *astrobiology* has arisen. Its domain is nothing less than the scientific study of the origin, distribution, evolution, and future of life in the universe.

How does astrobiology differ from earlier attempts to find life beyond the Earth? It is broader, and deeper. It is decidedly multidisciplinary, drawing on specialists in biology, astronomy, geology, planetary sciences, and many other fields. It was born in the midst of scientific and political turmoil.

Here's how it happened.

Action and Reaction

In 1994, as part of Vice President Al Gore's National Performance Review (popularly called "reinventing government"), NASA was ordered by the White House to cut $5 billion from its planned budgets for the next five years. This triggered a paroxysm of self-examination known as the Zero-Base Review, because the NASA internal review team started their work by assuming that nothing was sacred: everything in the space agency was being subjected to keen budgetary scrutiny.

By the spring of 1995, the review team proposed to NASA's top management "sweeping management and organizational changes designed to simplify operations, reduce overlap, and cut spending . . . all without curtailing space and aeronautics programs," which meant that jobs, facilities, and administrative overhead must all be cut.

One of the Zero-Base Review team's recommendations was that the Ames Research Center be closed down. Completely.

Ames is located at Moffett Field, California, nestled in the low hills of Silicon Valley along the Pacific coast, almost an hour's drive south of San Francisco, near Palo Alto and Stanford University. Moffett Field is still dominated by enormous hangars that once housed huge dirigibles such as the *Los Angeles* and the *Macon* in the 1930s.

The National Advisory Committee for Aeronautics built gigantic wind tunnels at Moffett Field in the 1940s to test new aircraft designs as World War II approached America. The facilities were named after Joseph Sweetman Ames, then head of NACA. In 1958, when NACA was incorporated into the newly-formed National Aeronautics and Space Administration, Ames Research Center became a major NASA facility, with expertise in aerodynamics, biology, and computer sciences. In 1994, the Navy base was closed and NASA took control of all of Moffett Field's extensive facilities.

Ames was a focal point for cutting-edge research in space biology, computer sciences, and the arcane field of nanotechnology. Aeronautics researchers continued to use the wind tunnels until they were shut down, victims of budget-cutting from Washington—and of the growing power of computers to simulate flight conditions without the need for wind-tunnel verification.

But by 1995, the entire base was scheduled for termination. Ames was to be closed down for good. The scientists who treasured the campuslike atmosphere of Ames believed their work was too important to be thrown away; they fomented a rebellion born of desperation.

"Ames is always on the brink of extinction," says Wesley Huntress, who was at that time NASA's associate administrator for space science. Soft-spoken yet capable of quiet good humor, Huntress explains that Ames has always been something of an anomaly within the space agency, a very good group of scientists, but not the agency's top center for either aerodynamics or space ex-

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NASA's Hierarchy of Centers

NASA is built around its centers. Critics claim the agency is not an organization so much as a collection of fiefdoms.

Kennedy Space Center is the prime launch complex, of course. The Johnson center, near Houston, is responsible for human space flight missions. The Marshall center in Huntsville, Alabama, primarily develops space transportation hardware, such as the Saturn rockets that sent astronauts to the Moon and, more recently, components of the International Space Station. The Goddard Space Center, in Maryland, deals mainly with space physics and astrophysics; the major orbiting astronomical observatories are in Goddard's purview, including the Hubble Space Telescope.

NASA's Langley center, in Virginia, has been the leader in aerodynamics research since the old NACA days. The Glenn center, near Cleveland (originally called the Lewis center), works on aircraft propulsion development. JPL, the Jet Propulsion Laboratory in Pasadena, has done most of NASA's planetary exploration programs, such as *Viking, Pioneer, Magellan, Voyager* and the more recent probes sent to Mars.

Ames seemed to be the "odd man out." The center had done excellent aerodynamics research, but Langley was NASA's lead facility for aerodynamics. Ames had acquired significant capabilities in computers and information technology, in biology, and in the newer field of nanotechnology.

But in 1995, Ames had no particular specialty to call its own, no area of expertise in which it was clearly NASA's leading center—except for biology. Biology, however, was not one of NASA's hot-button interests. (Human physiology, especially how the human body reacts to weightlessness, is of course of vital interest to NASA. Johnson Space Flight Center was and still is the leader in that area.)

The Birth of Astrobiology

Threatened with extinction, Ames' scientists and managers conducted their own internal review. They asked themselves: What can we do that no other center can do and yet is important to NASA's goals? In essence, they were wondering how they could evolve into an organization that could avert extinction.

They invited Huntress to join their deliberations. Huntress, then associate administrator for space science at NASA Headquarters, knew the Ames researchers well. He had done his Ph.D. work at Stanford University under Nobel laureate Cyril Ponnamperuma, a pioneer in studies of the prebiotic chemistry that led to the origin of life. Huntress' doctorate degree is in chemical physics, but he considered himself an astrochemist, and still does.

As the Ames group deliberated its own future, it became clear that the center's expertise in biology and computer sciences could be applied to studies of life in the Universe. But NASA already had an exobiology program. How would the Ames effort differ from what was already being done?

In Huntress' words, "Ames had the biology capability, but how to articulate it to NASA's management in Washington? How to find a place for it in the organization chart?"

The Ames scientists felt that NASA's exobiology program, good as it was, was too narrowly focused on astronomy and planetary geology, without enough emphasis on biology. They wanted to tackle the entire question of how life began and where it might be found beyond the Earth. They were interested in understanding the fundamental role of life in the Universe. Huntress suggested naming the new effort *astrobiology*. Now the task was to decide what astrobiology should include, and how it could be differentiated from the existing exobiology work.

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Astrobiology vs. Exobiology

Since the early 1960s, NASA has had a program in exobiology, aimed at seeking evidence of life on other worlds. SETI had been part of the exobiology program, until Congress cut all funding for the search for extraterrestrial intelligence.

When seeking life on other worlds, the first questions are: "Where do we look?" and "What are we looking for?" When the exobiology program began, the only answers that anyone could give were: "Look for a planet like Earth, and look for the kind of life we can recognize."

Exobiology was, therefore, dominated by astronomy and geology. Its major efforts have been focused on finding planets that might support the kind of life we are familiar with, and then looking for evidence that such life might exist there. Mars was an obvious candidate, and still is. The 1976 *Viking* missions to Mars carried apparatus designed to detect metabolism similar to the metabolic processes of Earthly organisms. With the hindsight of the ensuing quarter-century, such an approach was "naïve," in Huntress' words.

Meanwhile, a flood of new discoveries and ideas was sweeping the scientific world in the 1990s. The Human Genome Project successfully mapped all of our genes. Possible evidence for fossilized bacteria was found in a meteorite that came from Mars. Planets circling other stars were discovered. Jupiter's moon Europa showed that it might harbor an ocean of liquid water beneath its icy crust. Extremophiles showed that life on Earth could exist in environments that had previously been thought to be impossible. The Hubble Space Telescope and other orbiting astronomical observatories such as COBE (COsmic Background Explorer) peered back to the very beginnings of our Universe.

Awash in the excitement of these discoveries, in September 1996, Ames hosted the First Astrobiology Workshop, to which were invited leading researchers in astronomy, biology, geology and other physical sciences, as well as sociologists, psychologists, teachers and philosophers. About 200 people attended the conference, a turnout that stunned Ames' people; they had invited 80 participants. "This [astrobiology] was a revolution that everybody joined," says Ames researcher Lynn Harper. Delighted by the enthusiasm and spirit of cooperation shown at the workshop, she remarked, "There wasn't any of the usual status-quo resistance or competition from existing programs."

The workshop participants began the task of outlining the basic scientific content of astrobiology. Subsequent workshops, such as the 1998 Astrobiology Roadmap Workshop, refined the newborn field's subject matter.

Astrobiology's Domain

From the first, astrobiology was based on a shift in attitudes. Instead of looking for Earthlike worlds and Earthlike life, the new paradigm of astrobiology recognized that we don't understand life well enough to know what we should be looking for or where we should be looking. To search meaningfully for extraterrestrial life, astrobiologists realized that we must understand the origins and limits of life on Earth.

Astrobiology also encompasses the *future* of life in the Universe. How do living creatures alter their environments? How does a planet's biosphere alter that world? Will humans be able to live in habitats beyond the Earth? On other worlds? All this is part of the domain of astrobiology.

The workshop participants quickly realized that astrobiology must encompass nothing less than the study of all the aspects of life in the Universe. In the words of David Morrison, director of space sciences at Ames and eventually chief scientist of the Astrobiology Institute, "astrobiology addresses three basic questions:

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"How did life begin and evolve? (Where did we come from?)

"Does life exist elsewhere in the Universe? (Are we alone?)

"What is life's future on Earth and beyond? (Where are we going in space?)"

This agenda was much wider and deeper than exobiology's search for habitable planets. The exobiology work is an important part of astrobiology's goals; there is no fundamental conflict between the two programs. However, in the practical world of budgets and egos, some friction is to be expected.

Astrobiology is inherently multidisciplinary. As Morrison points out, it encompasses specialists in the earth sciences, life sciences, and space sciences, "including microbiology, ecology, molecular biology, paleontology, astronomy, planetary science, and chemistry."

The 1996 workshop and subsequent meetings developed ten scientific goals for astrobiology:

Understand how life arose on Earth. Is life a unique phenomenon, restricted to our one world? If not, understanding the origins of life on our planet will help us to identify the conditions we should look for in seeking life on other planets.

Determine the general principles governing the organization of matter into living systems. How do nonliving chemicals become living organisms?

Explore how life evolves on the molecular, organism, and ecosystem levels. Understanding the processes of life, from molecular to planetary scales, will not only be pricelessly valuable for our own use here on Earth, but will help us to determine the specific clues (*biomarkers*) we should look for when examining other planets for signs of life.

Determine how the terrestrial biosphere has coevolved with the Earth. Life does not exist separate and apart from its environment. Life has changed our planet, and it will presumably change any planet on which it takes root.

Establish limits for life in environments that provide analogues for conditions on other worlds. Once it was thought that life could only be found on the sunlit surfaces of planets that held liquid water. The extremophiles have taught us that life's possible environmental conditions are much broader than that. How extreme can conditions be and still be suitable for life? What are the "edges of the envelope" for life-bearing environments?

Determine what makes a planet habitable and how common these worlds are in the Universe. There are more than a hundred billion stars in the Milky Way galaxy. How many of them harbor planetary systems? How many of these planets might be capable of supporting life?

Determine how to recognize the signature of life on other worlds. What are the biomarkers that signal the existence of life? Should we look for Earth-sized planets with free oxygen in their atmospheres? Or ice-clad worlds that are heated from within? Should we seek the "signature" of chlorophyll in the light from a planet, or evidence of running water across its terrain? Or all of the above?

Determine whether there is (or once was) life elsewhere in our solar system, particularly on Mars and Europa. Current observations indicate that Mars and Jupiter's moon Europa are the two most likely places for us to find life. Many spacecraft missions are aimed at Mars; one (so far) at Europa.

Determine how ecosystems respond to environmental change on time scales relevant to human life on Earth. Since the earliest farmers, we humans have been changing the landscape, the atmosphere and the oceans of our world. Not only is understanding the effects of these changes important to our own survival on Earth, but such an understanding can help us to determine what we should look for when seeking evidence of intelligent life on other worlds.

Understand the response of terrestri-

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al life to conditions in space or on other planets. Can organisms (including humans) adapt to living off the Earth? Will we become denizens of many worlds, or will we (and possibly extraterrestrials, as well) always be restricted to the planet of our origin?

The Astrobiology Institute

With these ambitious goals in hand, in 1997 the Ames group presented their plan for astrobiology to Dan Goldin, NASA's chief administrator. Goldin enthusiastically supported the idea. Not only was he personally excited by the search for life on other worlds, he was also shrewd enough to understand that such a program could capture the imagination of the general public—which would mean more support for NASA by the taxpayers and, in turn, by the politicians who decide NASA's budget.

Moreover, the Ames approach did not call for the usual bricks-and-mortar of new facilities and organizational empire-building. Instead, the plan was to create an Astrobiology Institute to serve as a focal point for the research and enlist the talents of already-existing research organizations in academia, industry and government. Taking advantage of Ames' expertise in electronic information systems, the Institute would be a "virtual" organization with a bare-bones staff, linked to the various research groups around the country and overseas by electronic communications.

Nobel laureate Baruch Blumberg agreed to head the Astrobiology Institute. A medical doctor with a Ph.D. in biochemistry, his research leading to an effective vaccine for hepatitis B earned him the Nobel Prize in 1976. Under his leadership, the Astrobiology Institute now has 15 research teams under contract, most of them from universities and private research institutions.[1] In addition, affiliations have been made with research groups in Spain, the United Kingdom and Australia. Negotiations are underway for a French group to join, as well.

Researchers around the world now recognize the Astrobiology Institute as a prime center of excellence. When the Institute announced that openings were available for three additional organizations, 20 research groups applied.

"There are many good groups out there," Blumberg notes. He hopes to add still more affiliates, in time.

Electronic communications have allowed the Institute to stay small. "We keep a low overhead," he says, with pride, "and we have a very good staff."

There is still the need to travel, however, and Blumberg is constantly "on the road," despite his 76 years. He might just as easily be found in the tundra of northern Canada as in the Astrobiology Institute offices at Ames. He sees the Institute's primary task as building up a

WHO SAID IT FIRST?

The word *astrobiology* was apparently coined by the Russian astronomer Gavriil Adrionovich Tikhov in 1953. Director of the Institute of Astrobotany at Alma Ata, Kazakhstan, Tikhov spent much of his career studying Mars, and was one of those who believed at that time that "primitive" life forms such as lichens might exist on the red planet. In 1956, the Brazilian scientist Flavio A. Pereira published a book he titled *Introduction to Astrobiology*, and in 1953, Hubertus Strughold, of the U.S. Air Force's School of Aviation Medicine, used the term in his book about Mars, *The Green and Red Planet: A Physiological Study of the Possibilities of Life on Mars*.

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large body of basic scientific knowledge that can help NASA to plan missions seeking signs of life.

"An enormous amount of basic work is needed," he points out. Still, he expects the astrobiology program to soon begin providing the knowledge needed to develop space-borne instruments and observation tactics.

Scott Hubbard, who helped found the Astrobiology Institute and served as its first director, is now associate director of Ames. He maintains that the astrobiology program is already making significant contributions to restructuring the missions planned for Mars. Formerly the "Mars czar" at NASA Headquarters, Hubbard said that robotic probes of Mars such as 1997's highly successful *Pathfinder/Sojourner* were driven primarily by "hard rock geologists" and atmospheric scientists. Now the astrobiologists are helping the mission planners to prepare future probes that will carry instruments to detect organic chemicals, drill many meters into the Martian crust, and search for water. Astrobiologists are also making contributions to selecting landing sites on Mars and mission objectives.

Similarly, the new insights of astrobiology are now being fed into the plans for a probe of Europa and other robotic missions to the planets.

Budget Woes

Yet despite all this, other events intervened to shake all of NASA. Billion-dollar overruns in the costs of the International Space Station triggered another round of belt-tightening throughout the agency. Once again, the rumors coming from Washington hinted that Ames would be shut down. The terrorist strikes on 11 September 2001 threw all of the government's budgetary matters into upheaval. And Goldin, who had headed NASA longer than any previous administrator, abruptly resigned in October 2001. To take over the agency, President Bush named Sean O'Keefe, a veteran Washington insider whose only previous connection with NASA had been to severely criticize the agency for its cost overruns.

It seemed clear that O'Keefe, a former university executive and Secretary of the Navy who had most recently served as deputy director of the Office of Management and Budget (OMB or, in the words of many a scientist, "the bean counters"), had been chosen to bring NASA's finances under control.

As O'Keefe assumed the helm at NASA, the agency's big problem was the International Space Station. First proposed during the Reagan administration, the ISS was to be a model of international cooperation on the space frontier, with modules built by the United States, Russia, Japan and the European Space Agency. The ISS was intended to be a station orbiting around the Earth where scientists can study how the human body adapts to long-term conditions of weightlessness, and where other experiments can be done on chemical and industrial processes in microgravity.

Instead, the ISS has become something of an albatross. Russia has delivered some of the key components of the station, but only once the U.S. supplied the funding that the Russians themselves could not (or would not) provide. In essence, the American government paid Russia to stay in the ISS program. Like many major engineering projects, costs for the ISS have ballooned far beyond their original estimates, so much so that the station now houses only three working astronauts at a time, instead of the originally-planned six or more.

Many of the scientific experiments planned for the ISS have been postponed or dropped altogether, which infuriates the research community both within and outside NASA.

During his confirmation hearing in the Senate, O'Keefe said, "The immediate challenges confronting NASA today are, largely, not scientific . . . Rather, the challenges are more aptly described in

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management terms—financial, contractual and personnel focused."

Much of his Senate testimony dealt with the International Space Station's $4.8 billion overrun, and ways to fix it. Asked by Florida Senator Bill Nelson to outline his personal vision for NASA's future, O'Keefe spoke primarily of applying good business practices to the agency's management, which will allow NASA to continue its "exploration and technology enterprise and a science-driven agenda."

What does this mean for astrobiology? Naturally, many scientists fear that NASA's science programs will be trimmed or eliminated altogether in a wave of fiscal austerity.

Bruce Jakosky, who heads the University of Colorado's Laboratory for Atmospheric and Space Physics, one of the 15 members of the Astrobiology Institute, points out that astrobiology was "protected" under Goldin. Will O'Keefe keep the program safe from budget slashing? Jakosky has arranged a series of public symposia about various aspects of astrobiology and finds that the general public is "really excited" about the search for life in the Universe.

Huntress, now director of the Geophysical Laboratory at the Carnegie Institute of Washington (another Astrobiology Institute member), points out that even if NASA decides to close the Ames center, the Astrobiology Institute and its work will continue. The Institute can move elsewhere, if necessary. "The results to date are good," he says, "and talented researchers will find a place for themselves somewhere."

Michael Meyer, chief scientist for astrobiology at NASA Headquarters in Washington, says he "can't imagine cutting astrobiology." Currently funded at $40 million per year, the program is actually *too small* to make an impact on NASA's budget problems, he points out.

As of this writing, early in 2002, no one knows how the Astrobiology Institute or Ames Research Center or the International Space Station or NASA itself will fare in the coming years. The outlook for astrobiology is good, but events in the wider world of national and international politics can always intervene. Budgets are a year-to-year thing. Yet the challenge of learning about life in the Universe remains.

The Work Goes On

Astrobiology is based on a new attitude, a new approach to the search for understanding life's role in the Universe. It looks into the past to seek out the origins of life. It searches the heavens for evidence of life beyond the Earth. And astrobiologists are also attempting to comprehend what the future of life in the Universe will be. In particular, they are examining the problems and possibilities of long-term human existence in space, including the need to build self-sustaining artificial ecologies off-Earth.

Despite the scientists' fears and frustrations, despite the threats of budget cuts or a shutdown of Ames altogether, the work goes on.

In a greenhouse dubbed the "Archaean Gardens" on the roof of one of Ames' laboratory buildings, shallow pans of water house thin mats of microbial one-celled organisms, the type that first populated the Earth more than three billion years ago. Lovingly tended by scientists and technicians, these creatures from the dawn of life are showing the researchers how life changed and adapted to new conditions when our world was young.

In a computer center, a mathematical physicist is working out the ways by which inert matter became living protein. Down the hall from his office, chemists are putting his theoretical constructs to the ultimate test: can they produce a living organism out of ordinary water, carbon and other chemical ingredients? Can they create life in a test tube? Other researchers are simulating ice-coated flecks of dust such as those found in deep space, and finding that

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the first steps in the chemistry of life take place in such ice.

Not far away, an astronomer is testing a telescope and sensors that will be able to detect Earth-sized planets orbiting distant stars once the equipment is lofted into orbit. Earth-sized planets may be Earthlike enough to harbor life—perhaps even intelligent life.

Nearby, a lanky, bearded scientist is preparing for a trek to Antarctica, where he will search for life in dry frozen valleys and in the frigid waters of lakes that are permanently covered by thick layers of ice. He hopes one day to seek life on Mars or on one of the ice-mantled moons of the planet Jupiter.

The Ultimate Quest

Where did we come from?

Are we alone?

Where are we going in space?

Seeking the answers to these questions is more than a job, more than a career. As Jakosky puts it, "It's a spiritual experience."

Perhaps the great Renaissance scientist Galileo Galilei put it best:

[Scientists] seek to investigate the true constitution of the universe—the most important and the most admirable problem that there is.

The quest will continue. ⊡

This article was adapted from Ben Bova's forthcoming book, The Living Universe.

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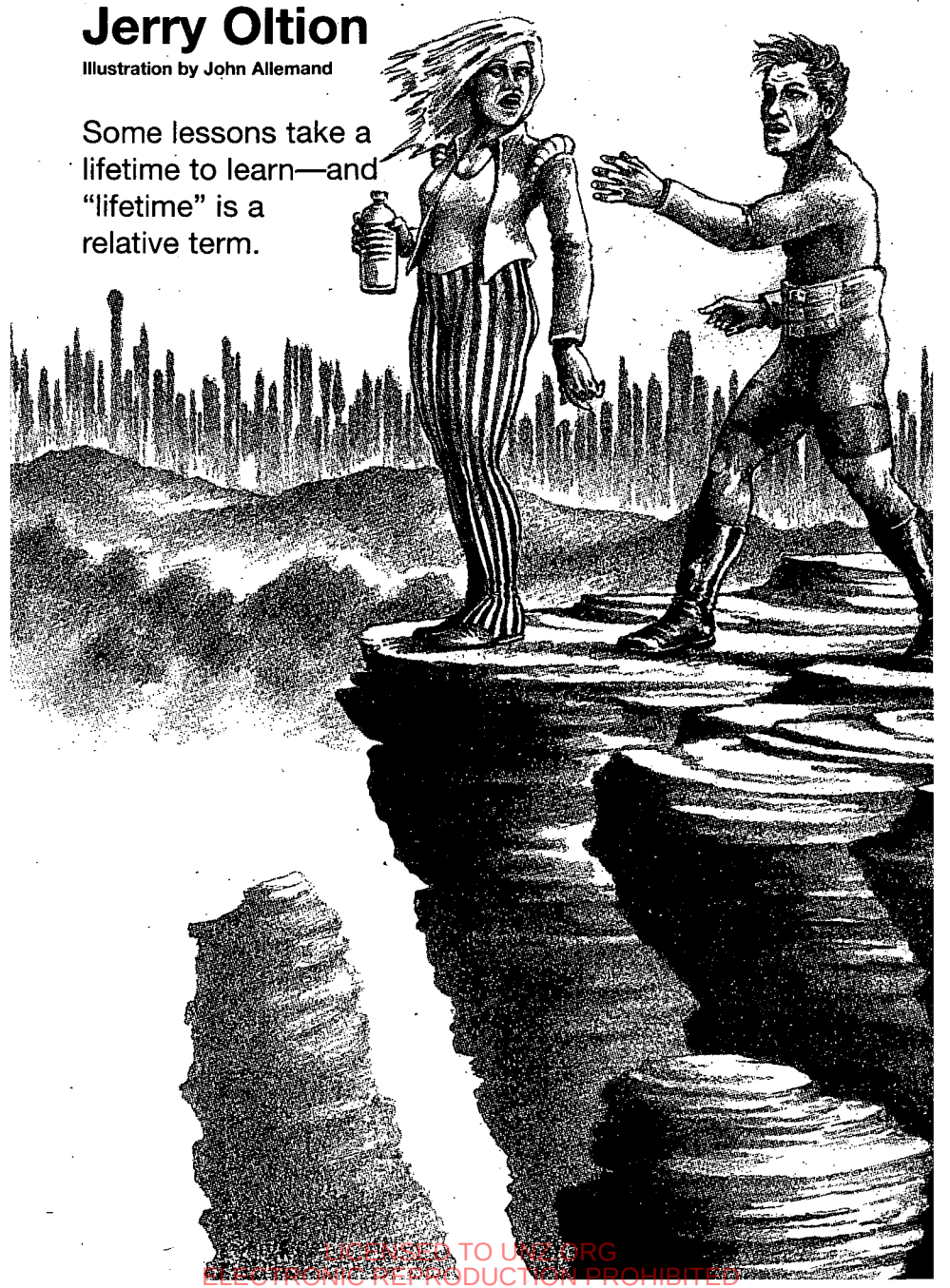
Witness

Jerry Oltion

Illustration by John Allemand

Some lessons take a lifetime to learn—and "lifetime" is a relative term.



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The immortal stood at the edge of the cliff, looking past the toes of his shoes to the talus slope below. A light breeze pressed against his back. One good gust would pitch him outward, where he would have about eight seconds to enjoy the flight before he struck the rocks, but the weather had been mild all morning; he didn't expect nature to make his choice for him.

Nor would the five witnesses who had accompanied him to the top. The three women and two men sat on weathered boulders a discreet distance away, sipping water and eating a light lunch while they waited. They were professionals; they had done this many times. They would not speak unless spoken to, would not offer advice unless asked. They had only one purpose: in the event that he jumped—or lost his balance and fell—they were here to confirm that Richard Demmer did in fact go over the edge, rather than skip out and start a new life somewhere else.

The pile of bleached bones at the bottom of the cliff attested to the number of people who had taken the quick way down, but in the last few years, Richard had talked with several would-be leapers who had walked back to civilization. He had that option.

He didn't expect to take it. He felt every minute of his three hundred and seven years on Earth, felt them as if each one had been a coat of paint layered over his psyche, their individual weight negligible but their accumulated tonnage enough to crush him under the burden of his own memories. It was a common enough complaint these days. The media called people like him "angsters."

Youngsters called them "ennuinnies" and celebrated when they opted out. They had reason enough to celebrate: World population was stable at forty billion, but only by dint of draconian fertility laws. Anyone who wanted a child had to inherit the birthright from someone who died, and death had ceased being inevitable nearly a millennium ago.

The peak was too high for vultures. Either that or they knew Richard wouldn't jump. If so, they were more certain than he. He hadn't climbed the mountain just to admire the view. He was a family man, and his family was counting on him to do the right thing. He had never let them down before, and he didn't plan to now.

On the other hand, he did have a few things to sort out before he jumped. A few thoughts to put in order. He had hoped he could put his mind at ease on the way up—one reason he'd opted for the cliff instead of merely taking poison at home—but the rocky slope had taken his full concentration, and now here he stood at the edge of the precipice, just as confused as ever.

It certainly was a nice view. Cloud Peak was the tallest of the dozen or so jagged granite mountains that formed the backbone of the range. From the top, he could see forested valleys stretching away in all directions, their silver streams and deep blue lakes glittering in the sunlight. Nearer at hand, the rough gray granite glittered with sparkles of its own, while beyond, the wilderness area came to an abrupt halt against the worldcity, whose millions of apartment windows sparkled just as brightly. Scattered cumulus clouds cast shadows over a few random blocks, providing more accent than shade, though above the horizon a wall of darkness promised a storm later this afternoon. If he didn't jump, he was likely to get wet on the way down.

Theoretically, no one would fault him for simply going home and resuming his life, but he knew how disappointed his granddaughter would be if he returned in one piece. She had been anticipating this moment since he had applied for the wilderness area entrance permit on his three hundredth birthday. She already had the name picked out for the baby. She had her pick of fathers, too, although Richard knew she had already

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decided on the musician. She was probably moving her things into his apartment even now.

Or into Richard's. His was nearly five hundred square feet, and he'd paid his rent through the end of the month. It would make a fine honeymoon suite. Teresa was not the type of girl to let that kind of opportunity go to waste.

He heard footsteps behind him, and the hair stood up on the back of his neck. He stepped away from the cliff and turned around, expecting to see one of the witnesses finally grown impatient enough to disturb him, but all five of them were still on their boulders, looking back down the rocky flank of the mountain they had climbed to get there. Four heads were rising into view: another leaper and his party.

Richard looked once more at the ragged line between rock and air. He should jump now and leave the mountaintop unencumbered for the next person. Then again, perhaps a bloody corpse at the bottom of the cliff would put them off just as badly. Hmm. What should he do? This wasn't the sort of social dilemma often discussed in the Population Control Bureau's coping guidelines.

He decided to wait. At least that way if he'd chosen wrong, he could correct his mistake.

The other people took their time reaching the top. There were two women and two men. It was hard to judge age in an era of perpetual health, but there were clues in the way people carried themselves. Even at a distance, Richard could tell that all four of the newcomers were old enough to be angsters. For a moment he wondered if they were all going to leap together, but then he remembered that there had to be at least three witnesses. They wouldn't have known that Richard's party would be at the top when they got there, so that meant only one of them intended to jump.

He stepped farther away from the edge as they approached. His witnesses hadn't greeted the newcomers, but Richard was under no obligation to stay silent. "Hello," he called out. "Nice day, isn't it?"

One of the women, a slightly overweight platinum blonde in a light green jacket, laughed, her voice thin and breathy from exertion. "Hah. It's a good day to die," she said.

"Yes," Richard said. "Yes, I suppose it is."

"A good day to stand on the edge and contemplate your place in the Universe, too, eh?"

"Mmm-hmm."

Her witnesses moved off to join his. She lowered herself carefully to sit on a rock beside him, then pulled her belt bag around in front, unzipped it, and took out her water bottle. She unscrewed the lid and took a long drink, then offered some to Richard.

"I've got my own," he said. "But thanks." There was something odd about the skin on her arms. It seemed thin and pale, and too large for her body.

She shrugged. "Nothing to thank me for. It's easy to be generous when you've got enough for the rest of your life."

"You're going to jump, then?"

The breeze caught a lock of her hair and dropped it into her face. Richard suddenly realized that it wasn't dyed white; that was her natural color. He tried not to stare as she tucked it behind her ear and said, "Not much point in climbing all the way up here if you're not going to jump, is there?"

He tilted his head toward the eight witnesses without looking away from her wrinkled face. "They did."

"Yeah, well, they're young. Young people do foolish things."

He wondered how old she was if she thought her witnesses were young. He suddenly felt uncomfortable standing over her, so he sat down on a rock beside her. It was slanted to the left, so he had to brace himself with a foot to keep from sliding off.

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"It looks like old people do foolish things, too," he said. "How long have you been off Telomase?"

"Fifty years," she replied easily, the way someone might say, "Since Tuesday."

"Fifty *years? Why?*"

She waved her left hand dismissively. "Why not? I knew I'd be bowing out in a few decades; there didn't seem to be any point in wasting the stuff."

"But . . . doesn't it hurt? You're wearing out! Look at your knuckles—that must be arthritis."

"It is. And yes, it hurts. I've got it in my knees and feet, too. That's part of why I decided to get it over with."

He didn't know what to say to that. The very idea of allowing a medical imbalance to persist seemed insane. Of course, wanting to kill yourself had once been considered insane, too, but still. . . .

"You don't recognize me, do you?" she asked.

"How could I?"

"Look." She tilted her head a little to the side, giving him a hint of her profile as well as the straight-on view.

He tried to see past the wrinkled skin with its dark blotches of melanin and bristly hairs sprouting from unlikely places. She had high cheekbones, a straight nose, green eyes, a narrow mouth with thin lips, and a pointy chin. She would have been a beauty when Richard was a hundred or so, but now the ideal was much more rounded.

Then she smiled, and the next thing he knew, he had slid off his slanted rock and landed hard on his butt. "Cindy McFadden," he said, his surprise and his pain giving her name the inflection of profanity.

"Ah, so you do know me," she said.

"By reputation only." He stood up again and extended his right hand toward her. "I—I'm honored."

"Oh, shut up," she said. "And sit down." The way she said it made it clear she wasn't angry, just tired.

He sat, this time wiggling the rock around and wedging it against another so it was a little more level.

"What was it like in the twentieth century?" he asked.

She laughed. "That's always the first question. The second one is, 'How many children have you had?' The answer to that is twelve, and the answer to the next question is that I was young and foolish. The eight who are still alive are all over seven hundred now. I've got sixteen grandchildren, eight great-grandchildren, five great-great grandchildren, and one gee-three. My progeny take up thirty-eight times my space. I'm not proud of that."

"You . . . but . . . well—" He swallowed and tried again. "Times were different then, weren't they?"

She took another drink from her water bottle, then set it down on the rock at her feet. *"Plus ça change, plus c'est la même chose,"* she said. "We knew we had a population problem back then, too. People were starving in Africa when there were only four billion of us. But I was from North America, and we didn't care about that. Africa was halfway around the world! It took a whole day just to get there. Of course, nobody would have gone even if it was instantaneous because it was so depressing, but we managed to ignore what was going on in Ethiopia and Somalia and the like. I had six kids before I could even *spell* Ethiopia.

"And then some fool figured out what makes people age. It took me another hundred years to have six more kids, but I was still an ignorant little breeder."

She looked out past Richard. "You know, when I was seventy or so, you couldn't have even seen Black Tooth from here, much less the city."

He looked out at the glittering mosaic of humanity that blanketed the foothills and the plains beyond, then turned around to see the peak she was talking about. Black Tooth was actually two ragged points of granite less than a mile

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away. "Why not?" he said.

She shook her head. "The air was too full of soot. By then we'd been burning coal and oil for electricity, and gasoline to power our cars, for almost two centuries. Some people were still burning wood for heat. Can you imagine that? The smoke got so bad people were dying from lung disease. That got our attention! We almost had it cleaned up before Telomase was invented, but when people stopped dying, the population pressure brought it all back within a couple decades."

"That's why you started the Population Control Bureau." It wasn't a question.

"That's part of the reason. I'd just had my tubes tied, too, and there's nobody quite so zealous as a reformed sinner. I wanted to atone for my dozen new consumers, and their little consumers as well. But I think what really got me was when we realized we didn't have enough energy surplus left to get off this damned overcrowded planet. By then I actually cared about things like that, but it was too late. We'd burned up all our oil, and all the methane in the seabottoms, and we even went back to nuclear fission for a while, until we blew up another reactor, but there was never enough energy to go around. We needed every kilowatt we could generate just to keep forty billion people from starving. We quit polluting the planet again because we couldn't afford to waste anything; but nobody had any dreams anymore. Certainly nobody was going into space anymore. We couldn't even imagine it. That's what finally scared me enough to do something."

He looked over at their witnesses, then scanned the sky for hovercraft, but no cars violated the wilderness area's ban. He was surprised; nobody would have broken the law or wasted the energy for him, but Cindy McFadden leaping off Cloud Peak should have drawn intense media attention. She must have sneaked away, maybe even planted rumors that she was going to jump somewhere else instead.

So, the oldest human alive was going to have the chance to die in peace. Who would have thought?

"Who did you will your birthright to?" he asked.

She didn't answer right away.

"Sorry, none of my business."

"No, it isn't. But you'll read about it tomorrow anyway. I didn't will it to anybody."

He felt his stomach lurch. A birthright was worth a fortune! Only convicted felons died without willing or selling their legacy to someone. Of course, there were plenty of people—usually childless couples—who thought Cindy was criminal enough to qualify, but she had never broken any laws. She had made them.

"When I'm gone," she said, "there'll be one less mouth to feed. One less consumer to waste energy on. And maybe there'll be just a little bit extra to go around."

She stood up and stepped toward the edge of the cliff.

"Don't jump!" He rose and followed her, reaching for her shoulder but unable to actually bring himself to touch her.

She turned sideways. "Don't jump? That's a pretty silly thing to say when you climbed all the way up here to do just that, isn't it?"

"But—we need you!"

"No, you don't. I waited four hundred years after the population laws went into effect just to make sure they'd work. They do. So now it's time to do the one last thing I can do to improve the world."

"But you're a leader. People count on you."

She tilted her head sideways. "People count on me? You're old enough to consider snuffing yourself and you still think that matters for something? You'd better give it another century or two of meditation, youngster. If someone is count-

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ing on you, they're taking advantage of you."

Her words hit him like a slap in the face. "That's not true. Just because people look to you for inspiration doesn't mean they're taking advantage of you."

"No? Then what exactly are they doing?"

"Admiring you! Listening to your message. Looking up to you."

"Letting me do their thinking for them. If that's not taking advantage, I don't know what is."

He struggled to voice his almost instinctive dissent. "What about . . . what about friendship? If I look to my friends for companionship, that's not—"

"Isn't it? Suppose one of them decides he doesn't want to associate with you anymore. How would that make you feel? Lousy, right? So you're counting on them to stay friendly, even if they don't want to. That's taking advantage of them."

She was wrong. She had to be, but he couldn't find the words to thwart her argument. "Babies," he said, grasping for an example from the thoughts foremost in his mind. "They count on their parents for food and protection until they're grown. That's not taking advantage, is it?"

The breeze stiffened, flapping her jacket open and shoving her a step closer to the edge, but she planted her feet firmly and pointed at the worldcity. "Look out there. That land used to be empty all the way to the horizon. Animals bigger than us used to live on it, sometimes only one or two per square mile. Now we're packed shoulder to shoulder hundreds high, and it's all because nobody can bear to deny a baby what it needs. They don't have to have an agenda to take advantage of our instincts. Not like your grandchild."

"My—how did you know about her?"

She rolled her eyes. "Why else do people like you kill themselves? Because some sweet young thing wants a family of her own. Well, make her wait until you're good and ready, because *she's* taking advantage of *you,* plain and simple."

There was no denying that. Richard had known it all along, but he'd convinced himself it was time to give up his birthright anyway. Now he wasn't so sure. He looked out at the horizon, trying to imagine the land out there without the buildings and the billions of people living and breathing and eating and excreting in them. It would be like the wilderness area, but without the seven-year waiting list to get in.

He looked back at Cindy McFadden. Dying without willing her birthright to anyone. Now that was an idea he hadn't considered. Nor had anyone else he'd ever heard of.

She wasn't done with him yet. "I don't suppose you know the meaning of life, either," she said.

"Do you?"

"Of course I do. And I can state it in two words: Die happy."

"That's *it?*"

"What more do you need?"

He looked out to the city again, then scratched his head. Die happy. Maybe that was enough after all. But oh, what a lot of changes he would have to make in his life to do that.

"Go ahead and take my water bottle for the trip down," she said, turning toward the cliff.

"Don't jump," he said again, and this time he did grasp her shoulder. "Please don't."

She gently removed his hand. "Sorry. I'm as happy as I've been in centuries. It's time."

Then, before he could react, she took three long strides, swung both arms forward, and sprang off the edge like a swimmer off the high dive. Her jacket flapped in the sudden rush of air, the sound quickly diminishing.

Richard held his breath, counting slowly to eight. There was a faint crunch like a person biting down on a yeast chip.

He couldn't bring himself to look over

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the edge. The three witnesses who had come with her did. One of them aimed a camera straight down, apparently unaware that his evidence would be useless to Cindy's heirs.

But then again it just might be the most useful image in the history of the human race. Richard walked back to the shard of granite Cindy had been sitting on, picked up her water bottle, and carried it across the rock-strewn mountaintop to the witnesses. It would be important to have something of hers when he spoke of what he had learned today.

"Let's go," he said to the witnesses, and he started back down the mountain, already thinking of what he would say to the media when he reached the bottom. ■

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Swap-Out

Shane Tourtellotte

When the world offers almost unlimited options, people may have to set their own limits.

Egan Brock sat down to work early, linking his office mainframe to the back of his shaved head. His personal module was plugged into the center socket of his implant suite, so he worked with the power of three brains. Well, two and a half: the natural item didn't measure up, in his opinion.

Coworkers filed into the office, taking their fastidiously arranged places. Even with telecommuting the modern norm, some people liked to see and interact with a traditionally staffed office. This firm obliged, enticing volunteers from its workforce to occupy an office designed to put forth the perfect impression to walk-in traffic.

Egan thought of it as easy bonus money, when he thought of it at all. Very few of those people came to interact with him, fortunately, so almost nothing distracted him from his work.

He had a fresh cache of designs from the firm's architects to test, and dove in. Every blueprint submitted had to be tested on a range of vulnerabilities, from wind to flood to earthquake to urban attack. Egan oversaw the process, and added some creative ideas of his own when the main programs got a little too predictable.

"Gotcha." The thirty-story office building projected into his optic center was supposed to be impervious to winds up to Category Two hurricane level, but that didn't factor in the channeling effects of nearby edifices. The model swayed and bucked like that old Tacoma Narrows flatfilm, until it collapsed from the puny force of a whole gale.

The spectacle was all numbers and images, but to Egan it was tactile, tickling nerve endings deep inside his head. It wasn't pleasure as such. That was too wet-brained a concept to comprehend the sensation. The buzz he got from sending back the model file with an attachment of its demise was much more

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old-fashioned.

He plunged back into work. Lunch hour arrived, and Egan ignored the shufflings of his coworkers, heading to the office pantry or out to diners. He worked until twenty before the hour, when his module reminded him to eat. He unplugged the cable with a sigh, got his bag lunch out of a drawer, and worked through it with vigor.

He was almost done when he noticed Kell approaching him. Kelly Borzas was in Accounting, a couple of years younger than he was. Not bad-looking, but hopelessly timid and shallow. The fact that she still had all her hair was proof positive.

"What can I do for you, Kell?" he rapped out.

She took a long second to answer. "You're the office expert on brain adjuncts, Egan. I was wondering . . . do you have any advice on my getting one of the new external models?"

Egan snickered. "I think it would suit you perfectly."

"Really?"

"Sure. You're the target market: a shrinking violet who's afraid of change, but not quite blind enough not to see she's falling behind the visionaries. You gladly take what you think is a baby step into modern times—but Kell, you can't cruise into the future on training wheels."

Kell took a step back. "I was hoping you'd be less dogmatic about this," she said, so slowly to Egan's senses that it took an effort to pay attention. "I've been reading up on the science, the short-range signal penetration and reception. It looked valid to me."

"Like Eskimo sex," Egan said. "Too many layers between the participants to get the real effect. I'm telling you from experience: if it isn't connected to the brainstem—" He gave a gentle pat to the module hanging onto his head. "—you aren't really cybered."

"From experience?" she said. "From experiencing it one way, you mean."

"From experiencing it the right way, since I was nine."

"Nine?" Kell gasped.

Egan relished the moment of shock, and followed it up. "It isn't so bad. Just shear it down to skin in the back, get one little operation . . ." He watched Kell's hand move protectively toward her hair. "Ah, so that's it."

She dropped her hand. "Didn't you ever find it . . . invasive? A violation, physically?"

"I don't have the kind of inhibitions you do. And even if it was, you shouldn't expect gains without a little sacrifice." He looked straight at her for the first time, smirking. "It's called future *shock*, Kell. You can face it, or stay tucked away in the twentieth century. You're welcome to come to my century any time, if that matters."

Kell shook her head. "I should have known," she said to herself, rather sadly, and walked away without elaborating. Egan shrugged, and reached for the cable to plug himself back into work.

"Have people always been such reactionaries?" Egan exclaimed. "It's a wonder we ever advanced to computers in the first place."

His home computer's voice interface rendered his words into text, and sent them to his friends currently occupying his Zone. Their computers had samples of his speech patterns on file, so they could turn the text back into a good rendering of his voice, thus conserving the bandwidth that always seemed scarce these days.

"It isn't just the wet-brains," Bay said, her voice rendered likewise. "I know a couple of cybered people who are planning on having their implants taken out so they can go with externals."

"What?" he howled. "And I thought Kelly the Hollow Girl was bad. That's—that's betrayal, turning their backs on human development. What's next, living in trees?"

"Power down, Egan," Garvey said. "I

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know someone like that myself. She's had trouble with inflammation, the implant area getting infected. She might even have had it removed if there weren't the fallback."

"Now that's just her fault. Some simple maintenance, some hygiene for freak's sake, and she'd be fine. God, I don't understand some people."

"You're being pretty harsh," said Lou. "Even if they're making mistakes, let them. It doesn't affect the rest of us."

"But it does. It retards the whole society, more than usual. Brain implants have existed for a quarter century, and still only 20 percent of people in this country have them. It should be 20 percent still wet-brains, at most. We should have had a cybered president by now. We shouldn't still be the stereotyped minority, played as brainiac zombies in half the stuff you see. Every implant taken out, every person who settles for an external setup, makes it harder on the rest of us."

"So what do we do?" Garvey asked. "Hit-and-run implant surgery?"

"I wish, but it has always been a matter of public opinion. A little constructive ridicule, some 'Where did I leave my brain' jokes, and we might get somewhere. I—whoa, my kitchen's signaling. Time to refuel. I'll link with you later, gang—and tell Lynne we missed her tonight."

After a chorus of good-byes, Egan thought a few commands to close his netlink and shut down the computer. He groaned, but his friendly module picked up the slack. He walked to the kitchen to unload the microwave, bending his neck to work out a kink.

Soon he was ready for bed. He undressed, leaving on just briefs and an undershirt, with its extra slack in the neck to accommodate his module. He sat on the edge of his bed, opened the toolkit sitting on his night-table, and picked out a lint and static-free swab. He cleaned out the cable jacks with practiced ease, inserting the swab without needing to feel around for the openings.

For the main socket, he wired himself to a small processor on the table before unhooking his module. Different brushes worked out the three prong-holes. With that finished, Egan picked up and attached his night-module. Technically he wasn't supposed to sleep with an implant, but that was old advice from overcautious and short-sighted doctors.

He eased himself down on his ergonomic pillow, built with a notch for the hardware, and let himself drift off.

The smoothness of the dreamscape turned jagged. Shards pierced his brain. His mind began tearing apart.

He awoke, frozen. Gingerly, he moved his head, and felt the prongs click back into place. He lay panting in relief, until the sleep-facilitating program reasserted itself.

I have to find something to stop me from tossing, he thought before falling back to sleep.

Two weeks later, a pause while a new file uploaded allowed his eyes to drift to the contraption on Kell's head. A thick band arched along her crown, supporting a squarish block at the back of her neck that was also braced on her collarbone. Dense brown hair spilled off both sides of the block, leaving a channel between her shoulder blades.

Egan unhooked from his workstation, walked over, and waited until Kell noticed him. "You're kidding," he said.

She flipped up her monitor visor. "Actually, yes." She smiled at his puzzlement. "It's a test brace, so my doctor can adjust the real thing to minimize the stress on my upper body. This is just a weight," she added, tapping the block.

Egan snorted, exaggerating the natural derision. "And you expect to go out in public looking like that. Boy, if you thought losing the Rapunzel look was going to crimp your social life—"

"It's only for work. The company will cover most of the cost that way. When I

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go home, it stays here." She arched an eyebrow at him. "That's all I ever meant it to be."

He leaned in close. "That's not all it will be. You'll find out. You'll want to use it for something outside work, just for convenience. Then it'll be something more, and something more, until it becomes a part of your life." He ignored Kell's shudder. "So since that's going to happen anyway, why not go all the way?"

"Anything I can help with, Mister Brock?" Grete Larssen, the office manager, walked up, trying to appear casual.

Egan's tone shifted. "Just inquiring about her . . . device." He withdrew to his desk before Larssen could suggest it. He watched Larssen speak to Kell, with a subtle gesture in his direction. Kell shook her head.

Larssen came over. "Work going well, Mister Brock?"

"As well as always," Egan said, jacking back into his workstation.

"You're still comfortable working in an office environment? The position was never required to be permanent. You can return to working from home any time, without prejudicing your standing with the company."

"It would prejudice my bonus. No thanks."

Larssen's voice dropped. "Then recall that this arrangement exists for customer and image relations. We need to look our best."

"And a cyber doesn't look right? That could be fun to argue in court."

"You know I didn't mean that," said Larssen, but she looked shaken. "Nothing insulates you if you're confrontational with other employees."

"I wasn't having a confrontation." Egan called up a model. "I've got nothing against Kelly Borzas—as an employee."

Larssen walked away, having had enough. Egan knew he wasn't finished, yet.

* * *

He sneaked a camera into work the next day. Fortunately, Kell still had her trial headgear. He snapped a pair of photos without being spotted.

That evening, he and two other pals from his Zone with similar pictures distributed them to one of the largest advocacy websites for cybers. Egan had composed captions, but the webmaster thought them excessive. Egan didn't mind. The ludicrous images spoke for themselves.

Those images got picked up by other sites, and eventually made it to one of the larger newspages for an article on external brain adjuncts. The piece wasn't derisive enough of externals for Egan's tastes, but it was a start.

Kell had stopped wearing her device the next day. Egan said nothing to her. If she had come to her senses, he didn't want to bungle it with a misplaced word. The next Monday, though, he wished he had said something.

This device looked almost the same as the first, but the big giveaway was the cable now running from the neck-band beneath her right ear to her desktop computer. Kell had gone cyber, in her pathetic little way.

Egan could see from across the room how happy she was with her toy. Officemates were equally enraptured, making excuses to come over and ask questions. He heard Kell answering them, her voice carrying more than usual.

"Yes, much faster."

"No, it doesn't hurt. Not even the tingles Doctor Shea told me about."

"My thinking isn't different. It's . . . more. I feel in control, and that's a relief."

She was the center of attention, the same way he was back when fourth grade began. No, not quite. These people were more childlike, all innocence and wonder and uncritical acceptance. Egan's old classmates—the ones who taunted him, made up insolently clever and humiliating rhymes, or just shunned him—they had the more adult attitudes.

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So typical of people, proclaiming their openness to change, as long as it doesn't change much, doesn't give them some appearance they can't get their minds past. Kids were better. At their most brutal, they were more honest about what they thought.

He had proved himself better than his boyhood tormentors. He'd do it again with this self-satisfied choirgirl playing at being just like him. He had the first step in mind already. All he needed was a couple of days to get himself ready.

"How's that thing working?"

Kell's half-closed eyes didn't blink. She was probably still having trouble getting accustomed to internal projection. "All right," she said.

"It's crunching all of your numbers properly? Wait, your desktop always did that job. I guess you just shuffle those numbers into place faster now."

"Oh, I do some of the math myself. I always did. I enjoy it." She opened a drawer on the side closer to him, and lifted out a calculator that had once occupied her desk. "I don't need this anymore, though. Not that I always did before."

"Wow. You're pretty confident of your abilities."

She finally smiled. "I've always been excellent at math. With this," she said, tapping her headset, "I'm faster than . . . well, faster than you with your implants, I'd bet."

Egan fought not to grin. This was almost too easy. "Bet? Sounds like a challenge, Kell. Double-entry bookkeeping at ten paces? And the winner gets what?" He started to turn away, affecting marginal interest in the matter. "Maybe gets the loser to take his next pantry duty."

Each employee in the office took weekly turns keeping the pantry clean, a universally detested job. Egan let it float there, like a casual notion, and walked back toward his desk.

"I'm game if you are."

He stopped, grinning. He hadn't angled often, but he knew the feeling of having a fish strike.

The showdown came on Friday, two days later. Egan and Kell chose Mike Leung to create a suitably complex accounting problem, at the cost of the loser taking over Mike's next pantry shift as well. They petitioned Larssen to let them hold the match during a lunch hour at the office. Egan let Kell do the convincing, knowing Larssen would mistrust him.

Noon arrived on Friday. The other workers moved the two receptionists' machines into the main office area. They had identical capabilities to make things fair, and the only external monitors in the office to allow for spectators. Kell offered her hand before they sat down, and Egan took it with a good simulation of sportsmanship.

Over half the office stuck around to watch. Most of them hovered around Kell. Egan did not mind. Sympathies are always with the underdogs—until they get trounced, and the winner's domination is all you remember.

Mike walked up with two jewel cases, and placed their contents in each separate disk tray. "On my word 'go,' push your buttons to insert the disks. You will have to calculate net balances for three separate dates, which are listed. Faster time wins. If you get one answer wrong, I double your elapsed time as a penalty. Get two wrong, and you're disqualified." He raised a stopwatch. "Ready, set, go!"

Egan got off an instant slower, and the data that then flooded into his head daunted him. Mike had created an utter tangle of receipts, remittances, accounts payable and receivable, interest tables, and all of it jumbled together, so randomized that there was no underlying pattern for Egan to find and exploit. Mike had earned his pantry relief.

That was the last thought Egan spared for the outside world, as he plunged into the problem. He had drilled on

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three varieties of accounting software to prepare himself over the last two nights. He started imposing order with his brains, while the mainframe handled the math. Yes, he could handle this.

She was probably peeking over right now, checking his progress. He counted on that indiscipline to distract her, slow her down. That's how wet-brains worked, and no toy supplement was going to change that.

"Done!"

He unplugged from the computer, leaning back in his chair. He craned his head over to look at Mike's stopwatch. The top number had stopped at 4:20.06.

"It took my computer half an hour to crunch the numbers, before I randomized the entries," Mike whispered. "You are fast."

"Yeah, I—"

"Done."

Kell sighed and wiped her forehead. Egan blinked, then looked at the stopwatch again. Kell had finished just fourteen seconds later than he had.

He sat stiffly while Mike consulted a card. "Kell and Egan got the same answers, and the right answers. The winner, and champion, Egan Brock." Mike raised Egan's unresisting arm.

The workers applauded, and some came over to congratulate Egan. More went over to console Kell for her near miss.

Egan awoke with the same racking questions he had left behind in the night. He linked to his nightstand machine to swap modules, then went into the bathroom to run the shower. He stepped inside with a plastic cap over the back of his head, keeping the important stuff dry, and started obsessing properly.

He should have humiliated her. Instead, she came off as the gallant competitor who fell just short, gaining honor in narrow defeat, winning sympathy. Getting routed by her would not have been much worse.

He was going to get the Stealth Bomb. He didn't care that his Zone pals thought he was overreacting, or that he was lucky to beat her at her specialty. He needed a stronger, faster module, to show them all.

His implanted connections could handle the extra volume. There was always an engineering margin, in bionics or architectural design or anything else. Getting fresh implants would be too costly, and would take him away from work for a week. Kell would know for sure that he'd upgraded, another moral victory for her.

Besides, he didn't trust a hospital to let him perform his own maintenance routines. More reactionary attitudes, clothed in fears of liability suits. They were too bound up in the biological to see things clearly.

He toweled off, and went into his computer room to link to the net. No reason to put off ordering. He needed that Stealth Bomb soon. He needed it now.

Nobody took a second look when he walked into the office a few days later. The Stealth Bomb was designed to appear just like a regular manufacturer's module, and the match with his old module was perfect. Only its abilities were different.

He held himself back while testing the latest building designs. Doubling his productivity in one day would look unusual. Better to spread it out, make it look more natural—even though the speed and power pulled at him, begged to be tested to their limits.

It took an effort to separate himself from the mainframe a couple of hours later, to go to Kell's desk. "Yes, Egan?" she said, resignedly.

"You came awfully close to nosing me out last Friday. Interested in a rematch?"

"No, thank you, Egan." Even with that pretend augmentation, she still talked as slowly as a wet-brain. "I can't match your experience with using an adjunct."

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"Hey, you're the one with the accounting experience. Then again, sometimes experience counts for less—say, when one side's got the superior hardware."

Kell's shoulders shifted under their braces. She said nothing.

"Come on, Kell. If you're using second-best equipment, better that you learn that now."

She still wouldn't look at him. The approach of Larssen sent Egan packing before he could try again. He fumed for the rest of his shift, when work didn't occupy his mind.

He linked up with his Zone that evening, and found Lynne there, returned from her long absence. Conversation stopped dead when his presence registered with them. "What did I do wrong?" Egan quipped, then more ominously, "Lynne?"

Others started to speak, but Lynne stopped them. "I'm not afraid to tell Egan, any more than I was with you. I had my implants removed three weeks ago, Egan, to switch to externals. I got spooked by some health reports, maybe more than I should have, but it's working out all right."

The screen blurred in Egan's eyes. He grunted, with a small trailing snarl in his throat.

"Now don't be ripping into her," Garvey warned.

"Did I say *anything* to her?" Egan shot back. "Guess I don't have to. You people already told her exactly what I think. There's no reason for me to be here at all."

And with a thought, he left. He spent a long, listless spell flitting around the net, fastening on anything that kept his brains active, involved, functioning the way they were meant to. Only belatedly did he retire to bed.

Egan went to work the next day doubly determined. No more holding back. Cybers had been too restrained for twenty-five years, almost apologetic, and now willingly diminishing themselves when they had the chance. No, he was going to prove his superiority, leave Kell in his dust.

He worked with fervid intensity. He stayed linked up and operating for the few minutes it took to bolt down lunch. He tried to keep working despite the nagging raps on his shoulder, but the body appearing before him was too imposing to ignore.

"It's half an hour past closing," Grete Larssen said. "Why are you still here?"

"There's still work to do. You go on home. I'm fine here."

"I'm not locking this office with you in it." She put a finger over the computer's power button.

Egan glared scornfully at her, and thought the machine off himself with a wince. "I'll just keep working from home," he said while unjacking.

Larssen looked somber. "I imagine so. Good night, Mister Brock."

He did as he promised, filling with his disaster simulations the time he would have spent in his Zone, and more. He turned in well past midnight, but was up before dawn, returning to the intricacies of the simulations that had followed him into sleep.

He made a show of arriving at the office precisely on time, not a minute early, to spite Larssen. After that, she couldn't stop him from working, putting building models through every test he knew, and a few he thought up on the spot. They all failed eventually. They couldn't resist him in the end.

Soon his work cache was empty. He sent messages to all the firm's architects, asking them to send more. He called on his fellow stress testers working at their homes, cadging excess files from them. Some came, but they didn't last long.

"What do you mean, you don't have any more blueprints? Get on the stick and draft some more. Do they pay you wet-brains out of feelings of charity?"

He felt the presence by his shoulder, but ignored it until she spoke. "Why don't you take the rest of the day off,

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Mister Brock?" Larssen said. "You look under the weather."

"I'm fine. Just let me work."

"And how much work do you have?"

Her expression was neutral, but Egan could feel the smugness beneath. Had she planned this?

"Fine," he said, raising his voice. More people joined those looking at them. "But I want it in your work log that I completed everything in my files, and that I'm leaving under protest."

"So noted," she said, raising a handpad to write on it.

Egan braced himself for disconnect, weathered it with a grimace, and walked pridefully to the door. He got one last look at the office, and saw Kell walk up to talk to Larssen. Disgusted, he stalked off.

He caught the bus just before it pulled out, boarding by the rear entrance. He sat midway forward, studying the passengers around him: their gestures, where they looked, whom they talked to and in what tones. They were all so transparent.

A woman laughed, and he stared her down. "I'm not a freak," he snarled, and she couldn't muster a response.

He turned away sullenly. "I'm better than you. I'm better than all of you. I embrace progress. I commune with the future. I've made it part of me. But you people—not one of you is cybered. You're all weak. You're all afraid!" A few of them looked it, too.

"Pipe down back there," the driver growled, "or I'll toss you off this bus."

"Might as well," he said, standing. "This is my stop." He took a look back at them all from the front, as the bus stopped. Something in the back caught his eye, someone he hadn't noticed before. A bowed head obscured the face, but exposed the long brown tresses.

Egan hastened off the bus, stumbling at the curb. He was getting paranoid, seeing things. Maybe he did need a break. He knew just the relaxation webpage he could plug into.

He reached the apartment building door as the bus lurched past. He stroked the touchscreen of the security computer, for voice recognition. "Let me in."

"Me too, Egan."

He whipped his head around. He was seeing Kell again, right behind him.

"Confirmation, please," said the computer. "Include or exclude companion?"

"It doesn't matter. She isn't there." He hauled the door open, and crossed the lobby.

"I am here," he heard behind him. "Egan, you're blazing hot and turning delirious. You need medical help."

"No doctors, thank you." He pushed the elevator button, got inside, and saw with annoyance that Kell, or whatever, followed him. "They wouldn't know how to treat me. I'm beyond them. They'd probably withhold my sleep module, and see where that would get me."

He shut his eyes, shook his head, and opened them again. "Still there. I'm gonna demand a refund. Their module's buggy." He grinned lopsidedly. "Still, it's got power. You're the most convincing human simulation I've ever seen—but why you? No, it's obvious. You're so insubstantial in real life, and here you are insubstantial now. Might as well be the real you."

Egan exited into the hallway. "I must be persecuting myself, generating you. Getting beaten by you was bad enough; now you're haunting me. Open." He walked into his apartment. "You'll understand if I don't invite you in, but I suppose you'll walk through the walls. I—I . . ."

The floor felt soothing, after the initial bump. He felt hands on him, fumbling toward his neck. He slapped them away ferociously. "Don't you touch that! Murderer!"

The hands moved to his midsection, and dragged him onto the couch. He curled himself tight, pushing his module into the corner. Then he began to drift, as the apartment dissolved into myriads

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of fluctuating data points.

There were sounds at intervals: what sounded like a woman making a phone call, a wooden rapping, a hushed conversation. He was lifted again. He locked his arms tight around the back of his head, hitting something hard that gave a yelp of pain. He alighted somewhere soft, and felt damp coolness on his head from something that covered his eyes.

"I've seen this before, Kelly," said a man's voice. "It isn't as rare as I'd like. His module's processing power is probably past the rating of his implant. It causes excessive electrical activity in the spliced nerves, and the areas of his brain stimulated by the augmented cognition. It creates a feedback cycle in his neurotransmitter use and production, which causes psychological dysfunctions, but it also triggers an autoimmune response we don't quite grasp yet. That produces the fever, worsening the existing symptoms."

"Is he—" Kell lowered her voice, a futile gesture. "Is his life in danger?"

"The fever's rather easily controlled. The neurotransmitter cascade will burn itself out." A sigh. "I may be trained in cyber-dependence, but I'm still just an attendant. I'd feel better with a doctor here."

"He said no doctors, John."

"Sure did," Egan thought he said.

"Yes, and you had to be honest enough to tell me that. But the law's on his side, so we're stuck." There was a settling sound. "So many cybers push themselves too far. With that extra thinking capacity, you'd think they would know better. It's tough to have sympathy sometimes."

He didn't want sympathy. He tried to tell them, but his thoughts didn't get through. Must be a bandwidth bottleneck. Just like wet-brains.

"He told me recently he got his first implants at age nine."

"Nine? Hmf. I take that back. Having that feeling of superiority instilled from a young age, when he isn't in control of his life? I can understand him better now."

He didn't understand anything. It was inferiority, being the slow one in class, enduring the kids' teasing, and the teachers who frowned or pitied. He knew how desperate his parents were, knew the sacrifices they had to make to help him, knew that it was his fault. Why would he want to return to that life, to retreat one inch toward it? Why would anyone not want to escape from mediocrity? He found the way. Why couldn't they?

Something brushed his cheek. "He was right about me. I was holding back, afraid of changing myself. When externals came out, that gave me a way around the dilemma. Now I'm afraid again, afraid that I'll end up like him."

"External adjuncts mitigate the neurological effects. The signals impinge on more nerves than the direct connections, spreading out the load."

"I don't mean the physical breakdown, John. I mean losing control of myself, turning egotistical, obsessed, as intolerant of change as . . . as he thinks I am."

Egan tried to look at her, but the damp cloth still covered his eyes, and his arm didn't feel like moving to lift it.

"Or am I rationalizing my prejudices, making excuses for staying safe and detached—literally?"

Feet shuffled over. "I can't claim expertise on your personality, Kelly, although you strike me as pretty level-headed. As for comparing adjuncts, working with dependents probably colors my judgment."

"But?"

"But externals strike me as the more . . . elegant solution. More efficient, less crude. The greatest effect for the least disturbance. That seems rational enough to me."

Kell gave a melancholy chuckle. "So what about Egan? I could keep him comfortable if that was all he needed, but it isn't."

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"We can't yank out the module, not against his will. Legality aside, you don't want a cyber holding a grudge against you."

"I always thought that was paranoia, John, the fears of cybers crashing nets, wrecking commerce."

"Probably so, especially with the protections in place today, but one person can still be vulnerable to one other determined, capable person. That's part of why everyone's tiptoed around the issue of cybers as though it were a live grenade. Even a fringe can be dangerous."

The counterarguments bubbled in Egan's mind: that persecuted minorities were the likeliest to become fringes, to lash out; that they would follow the avenue of attack they knew best. He made no effort to express those thoughts. It seemed so futile.

He drifted in and out of catatonia. Sensations on his skin reached him, like the replacing of cold compresses, or the application of a stick-tab thermometer. He held back the urge to fight out of his torpor, husbanding his strength.

His hearing faded out for a while, the silence penetrated only by indistinguishable voices. When he could make out words again, it was John. "—take the couch."

"No, John, go home and rest. You've helped me enough. I'll stay with him. No argument. It can't be you: He wouldn't recognize you. I'm not convinced he'd know me."

"I know," Egan said.

John grunted. "Call me if he starts saying actual words, or agrees to treatment, or anything."

The roar of his own thoughts running in tightening circles came back. Egan fought out of it, trying to scream. "Why can't you hear me?"

The fourth time he said it, Kell answered. "I can hear you, now."

He cracked his eyes open, and turned his head. "Ow. Ohh, my neck."

"I'm not surprised. You're lying on your module. Would you feel better without it?"

"Ugh. Really subtle, Kell." He gasped for breath. "But yeah." He rolled himself over with painful slowness. "Hand me the wire on the table."

Kell walked around the bed, and picked it up with distaste. "This one?"

"Yeah. That processor will support me. Give it." He saw her hesitate. "It's a less powerful machine. That's what you want, right? Oh!" His thoughts started swirling into a vortex again. "Hurry!"

She moved, but clumsily. Egan took the plug from her searching fingers, and slipped it in on his first try. He took a deep breath, then grasped the module with both hands and pulled. He spasmed, and almost put it back, but Kell's hands came bearing it away. His plea for its return dissolved in his agonies.

"Egan? Egan!"

"Don't—call—the Marines." His knees pulled up toward his chest. "It's just—a long step down." He flopped onto his back, disarranging the bedsheets, and panted. He could feel Kell's firm grip on his shoulder, see her alarm. The world was coming a little closer. He let it, for a long while.

"Why are you here, Kell? Or do you prefer Kelly?"

"Either's fine. My brother-in-law likes 'Kelly.' And how much did you hear?"

"Some. Dunno how much. Now what about my question?"

Kell stepped back. "You were sick. You needed someone looking after you, and—"

"And what?"

She opened and closed her mouth, then turned half away. "And I didn't think anybody else was going to do it."

Egan said nothing. He shut his eyes, waiting for more of his strength to return. It was some while before he decided it wasn't coming back. "Exhausted."

"It is late. You should get some sleep."

"I should. It's in the drawer." He waved with an arm.

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Kell was puzzled, for a second. "Yes, you mentioned a sleep module." She opened the drawer, but would only peer inside. She almost looked guilty at having it in her sight.

"Geez, you'd think it was a drug needle." He reached in, careful not to yank out his connection, and lifted the module onto the night-table. There he stared at it himself.

"What's wrong?"

"I—" He went silent for a few minutes. "I don't dream anymore, you know. With my modules in, my brain didn't produce enough of the right waves."

"What about when you weren't connected?"

Egan laughed. "The last time I wasn't connected was when I had my last implant replacement, when I stopped growing in college. Eight years ago." Kell exclaimed, but he scarcely noticed. "They produce these modules to stimulate the right pattern of brain waves. It simulates the effect of REM sleep. It gives you changes in the—the texture of unconsciousness that you can perceive. It doesn't give you dreams." His hand began to slip off the sleep module. "I think I miss dreaming."

Kell mustered a smile. "One step at a time, Egan. One step at a time."

"Yeah." He lifted the module a few inches, then dropped it back into the drawer. "You oughta know by now, Kell, I don't take baby steps." Before she could move, before his reflexes could kick in and stop him, he unplugged the wire from the tabletop processor.

Egan violently clenched into a tuck, whipping the cable by its purchase in his neck. The reaction wasn't physical, but mental. Intensely, tearingly mental, but what remained of his mind clamped down hard to stop it. As Kell held him steady, the tremors subsided.

His eyes stared ahead, hot with fear, but he made himself hiss, "Take it out." Kell detached the wire and stuffed it into the drawer. His body very gradually loosened. Concentrating on each part of his body as it moved distracted him from what was no longer there.

Kell shifted a soft, unmolded pillow under his head. He lay down, wondering at the odd sensation of his neck resting on cool linen. It soothed him, and he felt himself sinking.

He rolled his head, seeing Kell through closing lids. "It's not my style," he whispered, "but you do have nice hair."

"Thank you, Egan," he heard her reply, just before his eyes closed.■

How could I be expected to govern a country that has 301 different types of cheese?

—Charles de Gaulle

Don't be afraid to take a big step if one is indicated. You can't cross a chasm in two small jumps.

—David Lloyd George

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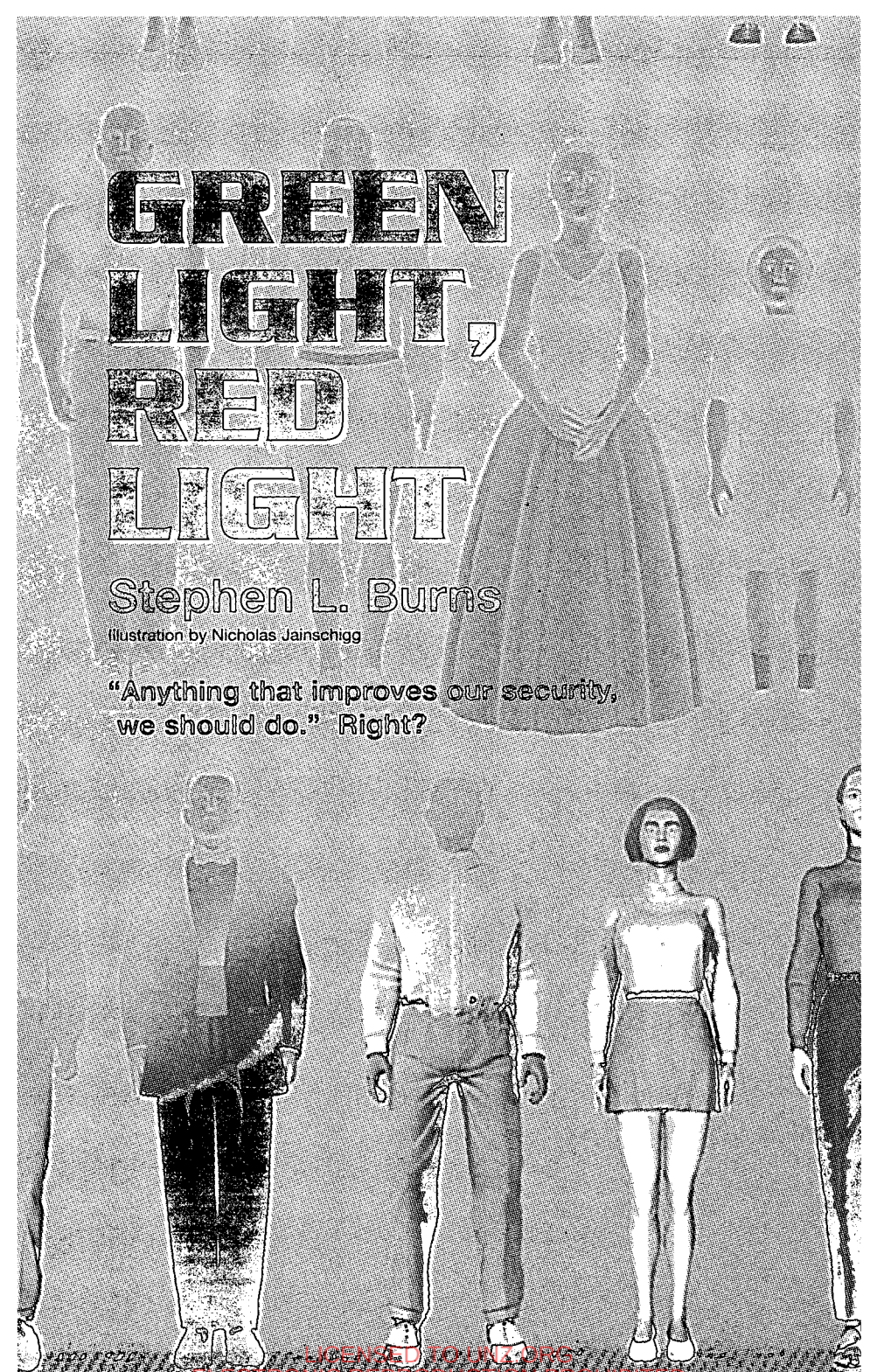
GREEN LIGHT, RED LIGHT

Stephen L. Burns

Illustration by Nicholas Jainschigg

"Anything that improves our security, we should do." Right?



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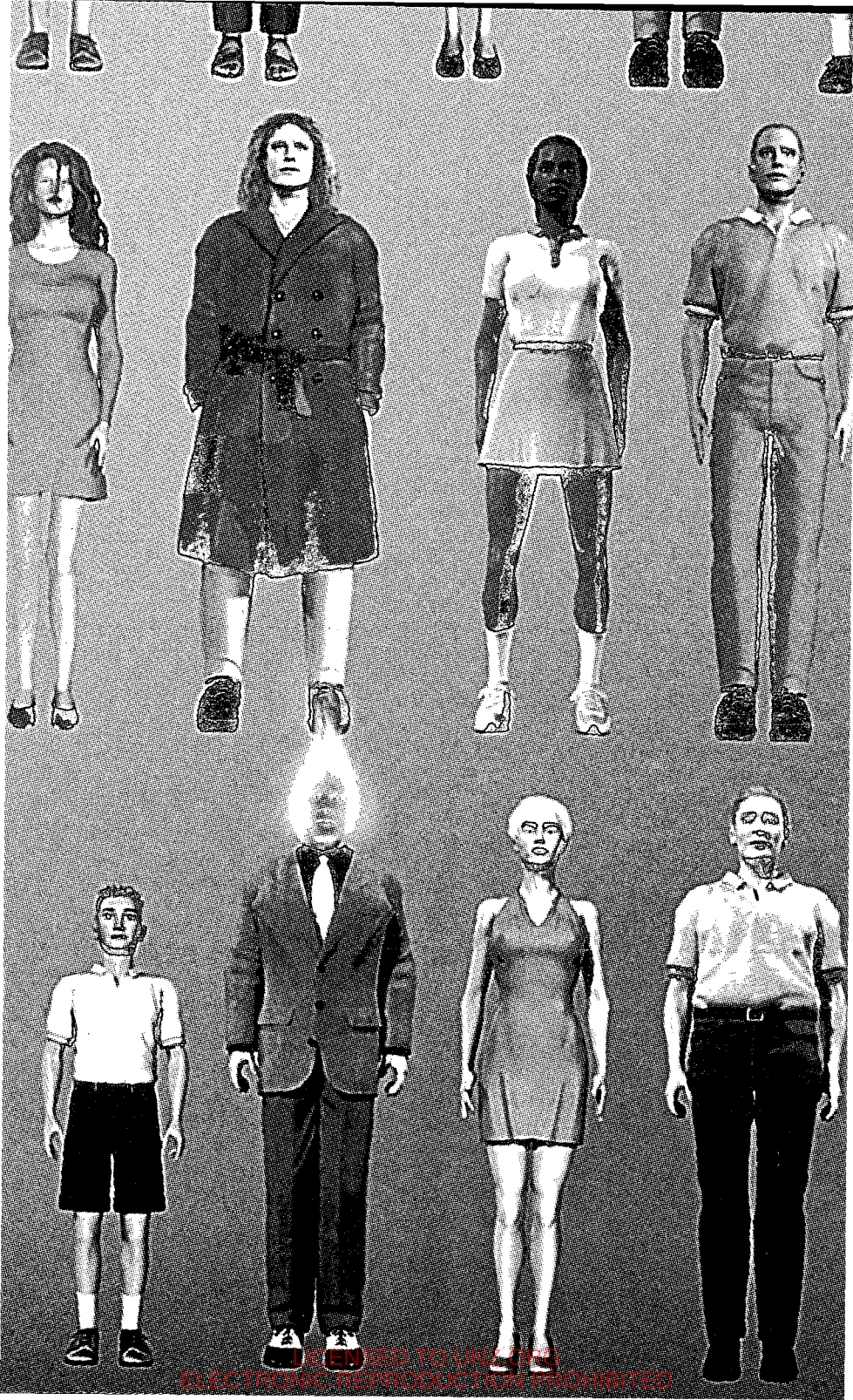

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Jools Watkins looked up the circuit diagrams he'd been studying when the door to his quarters opened. There was no knock beforehand; no asking permission to enter. Or, for that matter, way for him to leave.

Special Security Projects Director Thomas Olds stood in the wide doorway, flanked by two hard-faced men in dull blue suits. Both men had their jackets open, and hands on their sidearms. Their eyes were cold and watchful. Like Jools was a danger to anyone.

Jools sighed wearily, raked his short dreadlocks away from his face, and settled back in his chair as the security men entered and took up position on either side of him. The one on his right put his hand on Jools's shoulder in a silent command to remain seated.

Olds entered then. His face, which usually wore the tightly bland, faintly smug look of a functionary whose connections were solid and stock was rising, had taken on a haggard sag over the past two days. His mouth was set in grim determination, and when he stared at Jools hatred showed in his eyes. His suit was brown and nondescript, his tie a darker brown. The only color about him was the enameled metal American flag pin at his lapel.

"I've come to give you one more chance, Watkins," he said, trying to sound friendly and conciliatory, but failing.

"No," Jools replied calmly. "You've come back again looking for one more chance. Sorry. I'm not going to change my mind."

Olds took another step closer, jaw working as he tried to keep control of his anger. "I'm still in charge here. I can move you to some place a lot less comfortable." A hard stare. "I can make *you* a lot less comfortable."

Jools only shrugged. His quarters were okay, in a cold, impersonal, government-issue sort of way. He had his books, his computer, a passable bed, and a very good coffee maker. He could continue his work. His real work; the work Olds had forced him to put aside in favor of a project for the government. That project was completed. Olds was furious at and terrified by the way the project had worked out. Hence the threats.

Growing up as a skinny, geeky, half Black, half Cambodian kid in one of LA's worst neighborhoods had schooled Jools in how to deal with bullies and gangies. Olds, for all his suit and tie and lapel pin and Yale education, wasn't all that different from the BloodBoyz and Ruby Dragons he'd dodged on the streets. Only Olds was part of a federally funded gang, one that considered the whole USA its 'hood, and its strong arm tactics justified by the Holy Grail of National Security.

Jools shook his head. "That's not gonna happen, no matter what you say or do. You're not operating in a vacuum any more. The Attorney General and the Director of the FBI are watching."

Olds's smile was humorless, pitiless. "I don't see them here in this room, Watkins. It's just you and me. I know you can modify the SafeScan. Do it."

"Not a chance. It does exactly what it's supposed to."

"You know what it does wrong. Modify the signature firmware. Say it was too sensitive. Say the signature was a bit off. Say nothing at all." His voice rose and rang with appeal. "Just *do* it."

"I won't make it less effective."

"It's not effective, it's *wrong!*"

It was Jools's turn to smile. "Actually, it's perfect."

Olds closed his eyes a moment, mouth pursed tight, then stared at Jools again. "So I can't change your mind."

"Not a chance."

"Very well. Prepare to accept the consequences." His gaze flicked to the men guarding Jools. "Put this traitor on his feet."

They grabbed Jools under the armpits and hauled him to a standing position. Then they kept him in place by tight grips on his thin arms.

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Olds unbuttoned his suit coat, reached inside. Withdrew an automatic pistol. Jools felt a chill, and the hands on his arms clamped tighter.

Olds worked the gun's action, chambering a round.

"Uh, sir," the suit on Jools's left said uncertainly.

Olds ignored him. Satisfied that the weapon was loaded, he looked Jools straight in the eye. "Last chance. Will you modify the SafeScan?"

"Olds, you can't just—"

"*Will you?*"

Jools licked his lips, took a deep breath and prepared to reply, knowing that his life hung on his answer.

Two days earlier, he and Dr. Edie Blake, his partner in developing the SafeScan, were to demonstrate it before some heavy hitters from Washington. Olds had ordered them to wait in a small room two floors up from their lab space, giving the brass time to get settled in and briefed. The room's only amenities were two hard chairs and a carafe of lukewarm coffee.

Jools didn't so much pace as wander aimlessly—and continuously—around the room. Worries about how the SafeScan would perform weren't making him restless, he had absolute faith in what they'd built. His main concern was that after this demonstration he and Edie would finally be allowed to go back to the work which had gotten them dragged into the world of top secret, hush-hush, government-funded R&D.

Edie, who had worked with Jools as medical consultant for the past seven years had gotten shanghaied at the same time and wanted out just as badly. Over the nine months they had been "guests" of the government, her case of grandchild withdrawal had reached nearly epic proportions.

"Think this will really be our ticket home?" she asked as she brought Jools a refill of his coffee. This was the second refill, and the third time she'd asked that question in the last hour.

Jools smiled down at her and took the cup she offered. While he topped six and a half feet tall, she was barely five feet even. They made a great if mismatched team: him tall and rail-thin, skin the color of tarnished copper, dreadlocked; and her short, white, round, and old enough to be his mother. "It should be. It damn well ought to be."

"I know the SafeScan won't let us down, but I'm not so sure about Olds," she groused. "That man's nucking futs."

Jools laughed. "You've got to quit using those fancy clinical terms, Edie." He gave her a significant look. "Maybe we'll get some pudding out of this gig."

She nodded, showing that she knew what he meant by this odd turn of phrase. "I sure think we've earned some dessert. Could be tricky, though—"

The door opened, and Sgt. Sandra Zubin, a juicy brunette who acted as one of the project aides, stepped inside. She had a clipboard clutched to a chest which had drawn Jools's wistful gaze many times. "They're ready for you, guys."

"Then I guess we better be ready for them," Jools said, throwing Zubin a wink before putting down his coffee cup and taking Edie by the arm. "Come on, sugar. We're on."

"Yeah," she grumbled. "Dog and pony time."

They had never been told where they were, exactly, or seen much of the massive windowless building which housed their and the other projects under Olds's control. Their lives and their movements had been tightly circumscribed and compartmentalized. The floor where the demonstration was to take place was the closest to new scenery they'd seen for months.

Zubin led them down an aggressively nondescript corridor to a set of wooden double doors guarded by soldiers. These guards stepped aside, allowing them to enter.

They found themselves in a room almost long and high-ceilinged enough for

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a basketball game. The government officials waited for them at a long oak table just to their right. Opposite the table on the far side, just left of center, stood the SafeScan. To its left was a door guarded by a man in a blue suit. The right side of the room was home to a small cubicle walled off floor to ceiling with thick bullet-proof glass, a red light over the door. Beyond that was a larger roped-off area with a green carpet on the floor and over three dozen folding chairs. A green light marked the entrance to that area.

Jools turned his attention to their audience. Olds was there, of course. This was his show. He'd been the one who dragged the two of them into the program, structured the demonstration which would soon commence, invited the others who shared the table with him. Those invitations had been strictly A-List. Jools recognized every face at the table.

Olds began his pitch, clearly in his glory sharing a table with so much juice. "As you know, in my capacity as Special Security Projects Director I have several programs underway, some so secret even *I* don't know about them." He paused for laughter, and was rewarded with one or two polite chuckles.

"This is Mr. Jools Watkins, and his assistant, Dr. Edie Blake. For the past several months they have been working on a very special device. One which will make our lands and skies a much safer place in the future. Mr. Watkins, please begin."

"Sure," Jools said. It didn't escape his notice that the introductions only went one way. Not that it mattered. The people up there with Olds would be recognizable to any halfway well-informed citizen.

Sitting on Olds's right, and casually dressed in jeans and a denim shirt, was U.S. Attorney General Stella Luvadis, the tough and plain-spoken former State DA and judge from Montana. Sitting next to her was a balding, mousy man who looked more like some rumpled, absent-minded math professor than one of the nation's top lawmen, FBI Director Morton Stone. On the other side of Olds was the only black at the table, FAA Safety Czar Nate Freeman. He too was dressed casually in slacks, shirt, and FAA windbreaker. Beside him slouched the blue-suited, portly figure of famous—and to many, infamous—White House insider Senator Howard Little.

Olds had ordered Jools to begin the demonstration by giving a brief talk about himself and how the SafeScan had come into being. As if otherwise he might have started off with a puppet show and maybe a short bit of kung-fu breakdancing.

"Okay, as I'm sure you've already been told, I'm an inventor. I design, build, and patent non-invasive sensing and testing devices for use by the medical profession. This lovely lady is my second in command and medical consultant, Dr. Edie Blake. One of my most recent projects was an attempt to come up with a scanning device capable of detecting and diagnosing the sort of neurological disorders which at present are generally found through second-hand means, and only after fairly severe symptoms have begun to appear. The disorder which led me in this direction is schizophrenia. With that disorder, the earlier it is diagnosed and treatment begun, the better the sufferer's chances at leading a normal life."

No glazed eyes yet, so he continued on. "Toward that end, I created HoBACT, the Holographic Brain Activity Composite Tomograph, a sort of super 3D EEG." He shaped a sphere with his hands. "Neural activity in the brain can be thought of as a sort of three-dimensional matrix in which there are established pathways, detours, shortcuts and dead-ends. It might help to think of it as a city. Were you to observe it at night from above, you could easily see which roads and sections are busy, which are nearly dark and idle. You could see how the traffic moves, and from that extrapo-

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late how the city works. To image brain activity, HoBACT uses hundreds of exquisitely sensitive opposed sensors to take a new kind of 3D snapshot of this activity. Then using special software and a high-speed processor, that snapshot is compared to a database of normal snapshots we call signatures, the differences—if any—isolated and compared to a second database of predetermined pathologies. This is kind of like the way your computer's virus checker works. Some day, when this activity composite is better understood, decoding these signatures may lead to more targeted cures."

Senator Little had begun fidgeting during this part of Jools's explanation. Now he interrupted. "That's all just fine and dandy," he drawled. "But how's it lead to a security device?"

"To understand that, you need to understand how both sets of signatures were created. Dr. Blake and I tested over a thousand volunteers, some chosen because they suffered from already diagnosed conditions. For instance, once we'd tested a handful of verified schizophrenics, we had a signature which would allow the computer to identify a similar signature in an undiagnosed subject. The same for Parkinson's, and Alzheimer's. Rigorous conventional testing of the subjects afterward allowed us to verify the positives, some of whom had no known symptoms up to that point. That same testing allowed us to build up a library of signatures which could be considered normal. Over time we built up quite a catalog of maladies which HoBACT could identify."

Senator Little looked unimpressed—and like most of that had gone right past him. "Again, that's just dandy. I still don't see how you-all got to the point where you could build something *useful*."

Jools and Edie exchanged a glance, her lips silently forming the word *boob*. When he looked back toward the table he saw that both Attorney General Luvadis and FAA Safety Czar Freeman were eyeing Little like an ill-behaved chimp at a tea party.

"HoBACT will be *extremely* useful as a diagnostic tool, Senator," Jools answered patiently. "It was only in the course of pinning down the signature for OCD that we accidentally strayed onto the track which led to the development of the SafeScan."

Olds opened his mouth, but AG Luvadis spoke first. "OCD is Obsessive Compulsive Disorder, right Doctor Watkins?"

"Yes ma'am—though I'm just barely a mister. Edie—Dr. Blake—has enough degrees for both of us. Anyway, we thought we had OCD pretty well nailed down until a certain subject came along."

"*Eldridge Elias Petty*," Olds put in quickly, as if not wanting to let Luvadis beat him to the punch again. The others at the table all nodded in recognition of the name.

"Yes, though when we tested him we only knew him as Subject K-75. We were running the testing on two tracks at this point. One track was the testing of subjects with known, well-verified conditions. The other track was blind. By that I mean we had no idea if we were going to find any sort of disorder. When we tested Petty, the readings revealed a distinctly abnormal signature which was in some ways similar to OCD, and yet in others quite different."

Freeman nodded in understanding. "This was a pattern you hadn't seen before, right?"

"Yes sir. Dr. Blake is a certified specialist in, among other things, clinical psychiatry. She conducted tests and interviews with Petty. He exhibited none of the classical physical manifestations of OCD, nor any other particular pathology, although there were indications which pointed to either very slight—or very well hidden—sociopathic tendencies. We might never have figured out what those readings meant if he hadn't attacked one of the other volunteers."

Olds weighed in again before Jools

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could continue, no doubt to keep everyone aware that this was *his* show. "One of the other subjects was a young woman. When she showed up looking sick one day, a third subject asked her what was wrong. The woman admitted that just the day before she'd undergone an *abortion*." His distaste for the term and procedure was more than clear.

"Yes, she had," Jools agreed in a far kinder tone. "It turned out that she had been raped on three separate occasions by her building's super, and he was systematically terrorizing her to keep quiet. While she never dared go to the police, she did assert her right to choose not to carry the pregnancy created by this rapist to term. Petty heard her admit to the abortion, and went—"

"Apeshit," Edie supplied with a grin, getting a laugh from everyone but Olds.

"My learned colleague is correct. Petty attacked the woman, screaming at her that she was a murderer and beating her quite severely before staff and some of the other volunteers were able to intervene. Some of you already know what happened next. The police came and arrested Petty. When his fingerprints were run, they matched evidence collected at the scene of five different bombings. Bombings of family planning clinics. Bombings which killed seven and wounded over two dozen others."

"Acts which were committed across state lines," FBI Director Stone said. "We helped Ms. Luvadis build the case against him. Stella informed me that her office was going to, and I quote, 'Squash him like a shitbug in a pair of vicegrips.'"

"Actually," Luvadis said demurely, "I decided not to go that easy on the little bastard."

This by-play had caused Olds to scowl. "We are straying from the subject here. It turns out that they had not isolated some variant of OCD, but stumbled on something else entirely."

A pause for dramatic effect, then the big announcement. "What we have in the SafeScan is a way to detect and identify *fanatics*."

That got everyone's attention. The hijackings and plane crashes of 9/11, the anthrax spread in its wake, the bombings and hostage-takings in the four and a half years since; all were the work of fanatics, most of whom had remained unsuspected until they commenced their murderous work.

"You can *really* spot fanatics?" Stone asked Jools, both hope and disbelief in his voice.

"Yes," Jools answered. "As easily as someone trying to pass through a metal detector carrying an anvil."

"So you what, contacted the government?"

Jools allowed a bit of his anger and resentment to show. "Yeah, right. Somehow my private communications with some colleagues about how such a thing could be possible ended up in government hands. My contact with the government began when Olds here turned up with a platoon of soldiers and kidnapped Edie and myself."

"You were not ***kidnapped.***" Olds snapped.

Jools spread his hands. "Well, you haven't sent a note to my mother demanding money for my return. Yet, anyway—though with any more big corporate giveaways you may have to. Since then we've been kept incommunicado, and surrounded by armed guards. We are not here voluntarily. If I'd been asked nicely, I'd have gladly built the SafeScan. Instead we were given no choice in the matter."

"National Security doesn't leave *any* of us much choice," Olds shot back, clearly furious that Jools had dared air his discontent in public.

"Mr. Watkins, Dr. Blake," AG Luvadis said, her expression sympathetic and her tone placating. "My office has received more than a few complaints that Mr. Olds's tactics have all too often been rather . . ." A brief glance in his direction. "*Heavy-handed.* There are voices calling for stricter oversight, mine

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among them. I have noted your complaints, and I promise you they will be addressed. Still, we have reached a day when you have a device to show us. One which we are told may do much to increase the safety of our citizens. I for one hope that it may also ease some curtailments of rights and privacy enacted by those who give our status as a nation at war greater weight than our status as a democracy with a Bill of Rights and certain protections."

"So do we," Jools said, bowing in her direction, a gesture she acknowledged with a small smile and nod.

Olds let out a theatrical sigh. "Have we heard enough bleeding-heart stuff? Good." He pointed at the guarded door on the far left side, thirty or so feet beyond the SafeScan. "The test subjects, fifty of them, will enter through though that doorway. All will be led to and through the scanner. Those it flags as dangerous will be placed in the smaller red-marked high security holding area. Those who pass the test will go into the green area beyond. The identity and sex of each subject will be concealed. Are you ready to begin, Mr. Watkins? Or must we endure more whining?"

"We're ready." Jools and Edie made their way over to the SafeScan. Jools spoke softly, for her ears alone: "It's going well so far, don't you think?"

She snorted. "No threats of a firing squad, anyway."

The SafeScan wasn't much to look at, just a plain metal and plastic arch about as high and wide as a standard doorway. It didn't look all that different from a walk-through metal detector.

Jools turned back to face those at the table. "The SafeScan is completely self-contained, with the sensors, processors and signature firmware built inside. All it needs to run is ordinary house current—and less than 500 watts at that. Which means portable, rechargeable models would be easy to construct."

"Excuse me, Mr. Watkins," Freeman from the FAA called. "How hard is this device to operate and maintain? Is it something airport security personnel can cope with?"

"Maintenance consists of keeping it plugged in. As for use, you see that there are three big LEDs on the side of the scanner. The amber is lit now, showing that it's ready. The green light is an all-clear. The red light is an indicator that a fanatic has tried to pass through. If that happens, the light flashes and a warning buzzer sounds. In real-world applications it might be better to use a silent alarm to security."

Freeman nodded, pleased by what he was hearing. "That sounds easy enough. How long does this whole process take?"

"Only a second. Here, I'll show you." Jools went around and walked through the arch at a normal pace. The green light came on, stayed lit for several seconds, faded. "Not only is it bi-directional, it's fast enough to handle a lot of people moving through it at a pretty good clip." He turned and speed-walked back through. Once again the green light lit and faded.

"If by chance someone does go through too quickly for the test to be completed, it will let you know." He gathered himself, then ran through as fast as he could. This time the amber light flashed, and a chime sounded.

"That's fantastic," Freeman breathed. "Utterly fan-damn-tastic."

Edie drew herself up. "We, sir, prefer the term *spiffy*."

He beamed at her. "I'd say it's *way* spiffy, ma'am."

"Dr. Blake and I will show you the sequence of operations, step by step. Edie?"

"Sure." She approached the arch, halting just before entering.

"A proximity sensor registers her approach, taking the device off standby. It goes to standby if unused for more than ten minutes, in order to increase the life of its components. Warmup takes less than a second. Now as she enters the arch—" Edie took a step forward. "—the

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sensors begin to scan her, a dedicated chip adjusting for her changing position inside the sensor field." Almost as soon as she entered, the light flashed green.

"The scan goes to the processor which matches it against the signature for a fanatic. If a match does occur, a second scan is instantaneously run to confirm the first. Two positives set off the warning. As you can see, she passes. She may be crazy about her grandchildren, but she's not a fanatic."

That earned Jools a laugh from everybody but Olds.

Senator Little leaned forward, lips twisted into a conspiratorial grin. "I don't suppose that thing could be made to sniff out Democrats, Liberals, and commie types?"

"I'm afraid not," Jools replied, smiling back. "Though fine-tuning the signature for sociopathy might help identify some of the real heavy-duty flat-Earth Conservatives."

"Hell," Luvadis murmured, "That's easy. Just mention gun control, welfare, or the UN and watch for mouth foam."

Olds glared first at Luvadis, then Jools. "If we can dispense with these pathetic attempts at humor, we can begin. Would that suit you, Mr. Watkins?"

He shrugged. "Hey, we've been ready all along."

"Very well." Olds gave a nod to the armed guard standing by the far door. "Have them bring in the test subjects."

Jools wasn't sure what to expect. Olds had set up this part of the demonstration. All he and Edie knew was what Olds had said earlier: that the sex and identity of each subject would be concealed, and since there were some genuinely dangerous people mixed in with the rest, they would all be manacled and guarded.

He took a step back in horrified surprise at his first glimpse of the sorry parade which began coming through the doorway. Beside him Edie gasped, then hissed, "What *is* this shit?"

Each of the test subjects was covered all the way down to their ankles by a heavy canvas sack. Leg-irons with only a handspan of chain between them were locked around the ankles of each, forcing them to move with a slow, uncertain, shuffling gait made even more tentative by each being effectively blind. Each was escorted by a soldier who guided and controlled their charge by grasping one canvas-covered upper arm. In each of the soldiers' free hands was a pistol.

Stella Luvadis was the first to speak up, her voice ringing like a hammer on steel. "*Mister Olds!* You had better explain the meaning of this sick performance."

Olds met her gaze, looking genuinely puzzled. "This is supposed to be a blind test, Ms. Luvadis. Some of the people in that group have committed acts of terrorism. I have no intention of letting any of them get loose."

"Yes, but—"

At that moment one of the shrouded figures lost its balance, staggering sideways with a wail and falling heavily: In an instant the soldier guarding that prisoner had his weapon pointed at the rounded knob at the top of the sack, and bellowed, "*On your feet! NOW!*"

"*Don't . . . hurt me!*" The voice was muffled, shrill with fear. "*I'm just . . . a volunteer!*"

Jools and Edie acted as one, both going to the person on the floor. Edie dropped to her knees beside the supine form. Jools got right in the face of the soldier. "*Back off,*" he growled. "Now."

The soldier stared back, lips peeling back from his teeth. "*You* back off, sir. Both of you." The person inside the canvas sack huffed and gasped, clearly hyperventilating.

"*Tell this guy to back off!*" Jools yelled at Olds, gaze still locked with that of the soldier.

No answer from Olds.

"Stop this!" Stella Luvadis demanded. "Make him stand down!"

"One more warning, sir," the soldier

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said. "Step back."

Edie had dug around in her pocket and pulled out her pen knife. She flicked the blade open with a practiced motion, then brought the blade down toward the canvas so she could cut a hole and free the prisoner's face.

When the soldier saw what she was doing, he swung his gun to point at Edie's head. "*Drop the weapon! NOW!*"

Edie stared back up at him, her round face determined. "Don't be an idiot. This person needs air, and right now."

"*Olds!*" Luvadis's voice was sharp enough to make even the soldier blink. "*Stop this shit this instant!*"

"Stand down," he said tonelessly a few seconds later.

The soldier stared at Edie a moment longer, and after one final glare in Jools's direction, raised his weapon so it was pointed at the ceiling and stepped back.

Jools knelt beside Edie, and together they carefully worked a hole in the canvas, widened it, exposing the pale, frightened looking face of a young man with red hair and beard.

"You're okay, son," Edie said soothingly as she and Jools cut more of the canvas away. Soon his whole head and chest were exposed. Stuck to the front of his shirt where a name-tag would go was a large green label reading CLARK DAVIES/VOLUNTEER.

Jools read it aloud, then turned back toward the table. "Nice going, Olds," he said, his voice thick with sarcasm. "You almost got an innocent civilian shot, and you let a gun point at Edie."

Olds stared back, cold and unrepentant. "Take that subject out of line and begin testing."

"Did you hear what he just said?" Luvadis demanded.

"I heard."

"And?"

"And nothing. It was my intention for this test to be conducted in the most secure manner possible."

"What just happened doesn't *disturb* you?"

"The fact that someone was able to smuggle a bladed weapon in here is what disturbs me."

Edie had just helped Davies sit up. "I didn't smuggle anything in here, you pompous dickhead," she growled over her shoulder. "I've carried it every day I've been here, and for years before you dragged me to this goddamn place." She nudged Jools. "Help me get this guy up."

Together they helped Davies to his feet, then steadied him as they walked him over to a seat in the green area.

"Somebody get that bag and those cuffs off that poor bastard," Nate Freeman said, glaring at the soldier who had been in charge of Davies. "Then we better either get this misbegotten test run, and fast, or pull the plug and get those frigging sacks off before someone suffocates."

"Agreed," Luvadis said. "Mr. Watkins, Dr. Blake. Could you please run the subjects through the SafeScan without further delay? And once they have gone through and are in their proper area, I want no delay in their guards freeing them from those bags."

"Taking charge, Stella?" Olds's voice was soft, but the menacing edge in it was unmistakable.

Jools got a very good look at the "Steel Montanan" Stella Luvadis who had faced down every inquisitor and detractor at her confirmation hearings the year before. Outcry over the excesses of her predecessor had led to his recall, and another ultra-right wing candidate was not going to make the cut. A life-long independent put up as a compromise candidate by moderates on both sides, but who did not have full party backing from either, it was her implacable and unshakable dignity, self-possession, and integrity which had gotten her though.

"I was brought here to witness the demonstration of a device which would, I was told, help increase the security of our citizens. Instead I've been treated to the sort of cruel, ugly, demeaning, ill-conceived spectacle worthy of some

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amoral fringe group. This loathsome display must be concluded, Mr. Olds, and concluded now. Any more delay, or threats of violence, and my office will assist every subject involved, terrorist or not, with bringing every charge and lawsuit I can think of against you and your program."

Jools didn't wait for Olds to respond. He turned back to the ragged line of prisoners snaking out the door. "Please begin leading these people to the archway. Dr. Blake will call out the determination as to whether they go to the green or red section. Once you have them in that section, release them from those damn bags, and get the hand and leg cuffs off the volunteers."

The lead soldier gave Jools the ghost of a nod, then raised his voice. "Detail, please follow Mr. Watkins's orders. Take them through fast, but easy. Let's move." Then he began shepherding his prisoner to and through the arch.

"Green," Edie called.

Jools nodded to the next soldier. "Okay, your turn."

The test subjects were herded through the SafeScan at least as quickly as they could have gone through an airport metal detector. By the time the last one had passed through, nine had been sequestered inside the section walled off with bulletproof glass. Forty-one, including Davies, were now unguarded, unbagged, and unmanacled in the green area.

The name and record of each identified as a fanatic were read off as their bags were removed. Among the nine were four convicted members of various terrorist cells, all of whom had committed acts of violence. The SafeScan had also red-flagged a glaring, heavily tattooed skinhead who had killed three black women and two Pakistani boys, a man who had set fire to several gay bars, a man who had molested and killed five children, a Muslim immigrant responsible for the hit and run beating of over thirty unveiled women, and a woman who had poisoned nearly two hundred dogs.

Jools recognized a few of the people in the green area who wore tags reading VOLUNTEER as staff members from Olds's program. From the expressions on their faces he guessed that most had been as much volunteers as he and Edie.

"There you have it," Olds said, sounding extremely pleased with himself. "You may have qualms about the way I chose to demonstrate the SafeScan, but you must agree that the results speak for themselves."

Nate Freeman was the first to speak up. "I've got to admit I'm impressed," he said. "Were we to check not only all airline passengers, but all staff, and use it to control access to baggage areas and airfields, we could cut the threat of hijackings and bombings way the hell back."

"Precisely," Olds agreed. "SafeScan could be used to screen access to government and public buildings, and to the areas around embassies and military bases, both here and on foreign soil. People attending events where the President or other high-ranking officials were to appear could also be checked."

"There's got to be a downside," Senator Little opined gloomily. "Everything these egghead types come up with has one. Usually it's price. So what's the deal, Watkins? They're gonna cost a million bucks apiece or something, right?"

Jools shook his head. "I've only run a rough cost analysis," he replied, trying to keep from responding to Little's snide tone and slur. "I estimate that the first units will run somewhere around seventy to eighty thousand dollars each. Once the component parts and the device itself goes into mass production, and barring it becoming some overpriced pork barrel project, the price should drop to somewhere between ten and twenty thousand each."

"Huh. How does that compare to metal detectors? Is it more?"

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"No," Nate Freeman answered. "It's less. Plus metal detectors are fussy damn things, either too sensitive or not sensitive enough."

"Sensitivity isn't an issue with the SafeScan," Jools explained. "While the pattern for fanaticism isn't exactly the same in everyone, it does have certain markers unseen in other pathologies. Certain pathways are missing—one of them may even be the conscience—and others are overdeveloped and follow aberrant routes. We have a base of fanatic signatures, and I believe our model can identify all variants."

"Can it throw false positives?" FBI Director Stone asked.

"It hasn't so far, and we've tested it on all sorts of people. A devout nun or priest won't set it off. Nor will a golf nut, computer gamer, or sex or gambling addict. Only someone whose belief in something is so strong that all other moral or ethical considerations mean nothing will fit the signature." A hard look at Olds. "Either someone is a fanatic, or they're not."

Olds stared back, first scowling, then his eyes widening as he understood Jools's veiled accusation.

Nate Freeman stood up and bowed in Jools's and Edie's direction. "I know you folks were dragged into developing this thing, and for that I apologize. But you've created one hell of a tool here, one that can help make the world a lot safer. There may not be a Nobel Prize for Public Safety, but there sure as hell ought to be."

"Thanks, sir," Jools replied. Beside him Edie grinned.

The whole time Olds had been staring fixedly at Jools, then the SafeScan. He tore his gaze away, licked his lips. "Now you can see why I felt it necessary to not let the niceties get in the way of the SafeScan's development."

AG Luvadis shook her head. "Civil rights aren't *niceties*."

Freeman looked from Luvadis to Olds, then back toward Jools. "Whatever the case, we owe you an enormous debt of gratitude. Your machine is the answer to a prayer."

Jools smiled back, then launched the offensive he and Edie had discussed in those rare moments when they were sure no one was listening in. "Thanks. Want to give it a try?"

"Sure. Why not?"

The FAA man made his way around from behind the table and approached the SafeScan, his steps slowing and halting just before stepping inside the arch. "Will I feel anything?"

"Not a thing," Jools assured him.

"That's right," Edie agreed. "The dizziness, impotence, and inability to pronounce the word 'garage' will pass in seconds."

"I'm sure glad to hear that." He strode through the arch, his broad shoulders hunching ever so slightly as the unseen fields read him.

"You get a green light, Mr. Freeman," Edie announced.

Freeman chuckled. "That's good. Wouldn't want to get barred from the places my job takes me. Though to tell you the truth, a bit of a break would be nice."

"Anyone else?" Jools said, asking the room at large but looking straight at Stella Luvadis. She stared back, then her eyes widened slightly and she smiled.

"I believe we should *all* try it," she said as she stood.

Morton Stone looked up at her a moment, then got to his feet. "Come on, gentlemen. Don't let Stella show everyone that she's got more balls than we do—though she probably does, anyway."

Luvadis went through the SafeScan wearing an odd half-smile, as if daring the device to finger her. It didn't. Stone walked through like a tourist, craning his neck to examine the underside of the arch on his way through. Senator Little went through more cautiously, each step placed as if he was walking on hot coals. In each case the red light re-

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mained dark.

That left only one person who had not passed through the SafeScan. Luvadis faced the table and put her hands on her hips. "Well, Olds, you're the only virgin left."

He gave her a tight smile. "Thanks, I'll pass."

"What's the matter? Chicken?"

"I've already been through."

Jools shook his head. "No you haven't."

Olds's mouth tightened. "Certainly I have."

"Bullshit," Edie announced. "I've seen every test result this thing has ever given. You've never been through it. Probably never thought you would ever *have* to go through it. Guys like you just assume you'll never have to put up with the same security squeeze the rest of us suffer."

"Even if you have been through," Luvadis said softly, the voice of sweet reason. "Then why not go through it again?"

Olds only shook his head.

"Come on," she continued. "What's the problem? Too lazy to get up and walk all the way over here?" Her gaze sharpened, and her mild tone turned flat and hard. "Or have you figured it out?"

"Figured *what* out?" Senator Little demanded in an aggrieved tone, looking from one to the other.

"That the SafeScan would pick him out as a fanatic."

Luvadis's accusation hung in the air, waiting for some answer. Stone watched Olds with bemused interest. Freeman crossed his arms and waited impassively. Senator Little looked confused.

"Please," Olds said at last with a false heartiness. "This demonstration is over. You all have places to go and people to report to. I trust you will testify to how well this program has succeeded."

"I'm in no particular hurry," Nate Freeman said. He turned toward FBI Director Stone. "How about you, Mort?"

"I've got time. And I do find it odd that Mr. Olds is refusing to subject himself to a technology he himself had a hand in developing. A technology he expects us to push. What do you think, Senator?"

Little shook his head and held up his hands, refusing to take a position or even get involved.

Stone didn't seem surprised by Little's inaction. He gazed thoughtfully in Olds's direction, sighed. "In times like these my bureau has to guard against the traps of expediency and overzealousness. Because even in times of war there are lines which should not be crossed. And there are people more inclined to cross those lines than others, people whose dedication or patriotism has become something unhealthy and all-consuming. I went through Mr. Watkins's device without a problem, but I have to wonder if old J. Edgar could have. I too have heard many things about you and your methods, Mr. Olds. I tended to discount them as the usual nay-saying and backbiting. But having seen you in action, I have to wonder if perhaps you have lost sight of those lines which we in office have a duty to observe."

"I am a patriot," Olds said coldly.

"Oh, I have no doubt of that. Timothy McVeigh was one as well. So tell me, sir, are you afraid to prove that you are one of us, not—" He pointed to the slumped, glowering figures behind the bulletproof glass. "—one of *them*."

"These accusations are ridiculous. I refuse to respond to them."

"No," Luvadis said. "Your resistance to subjecting yourself to a test designed to keep this country safe is ridiculous."

Olds appealed to Senator Little. "Please, Senator. Can't you do something about this nonsense?"

Freeman never gave the man a chance to answer. "If the good Senator doesn't report to the White House that the head of this project steadfastly refused to undergo a test designed to weed out those dangerous to society, then I will. And I'll make damn sure the President understands that the Senator omitted that bit

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of information in his report."

"As will I," Stone agreed.

"Got a good fix on the way the wind is blowing, Howard?" Luvadis asked, one eyebrow raised in inquiry.

Little nodded glumly. "Go through the fucking scanner, Thomas. Not doing it is going to look bad. I got you this job. I won't have you making me look bad."

Olds stared at his former ally, shoulders slumping as he realized that he'd just been left to twist in the wind. Then he squared his shoulders up again and forced a smile, one bereft of humor or pleasure. "Very well. Let's get this stupidity out of the way. Some of us have real work to do."

He stood up and slowly made his way around from behind the table. When he approached the SafeScan his back was straight, his jaw set, his eyes hooded.

"Right through here, sir," Edie said sweetly.

Olds ignored her and marched into the SafeScan.

The red light flashed and the alarm bell sounded almost instantaneously.

Failing the test was not a sentence; no mechanism had yet been created for dealing with those who failed. All Luvadis and Stone could do was warn Olds that they were watching, and that it was likely his tenure as Special Security Projects Director was nearing an end. Little slunk off in a hurry, probably to polish up his deniability.

Less than an hour after the last of the witnesses to the demonstration left, Olds confined Jools and Edie to their respective quarters. In the two days since, he'd made several visits to Jools, each time demanding that the SafeScan's warning signatures be changed so that he and others like him would not trigger the device.

At first this latest visit had been much like the others, different only in the amount of time Olds had left with the theoretical leverage to get those changes made.

But when he pulled out a gun, his demands and Jools's refusal to meet them became something else altogether.

Olds had chambered a round, face stiff and still.

"Sir," the blue-suited security man on Jools's left said uncertainly.

Olds ignored him. Satisfied that the weapon was loaded, he looked Jools straight in the eye. "Last chance. Will you modify the SafeScan?"

"Olds, you can't just—"

"*Will you?*"

Jools licked his lips, took a deep breath.

"No," he said softly.

Olds pointed the gun at Jools's forehead. "America *needs* me. America needs people *like* me."

"Mostly to clean up the messes people like you caused in the first place," Jools answered quietly. "There's always a crash when madmen are allowed to drive."

"I'm not *crazy*. I'm someone who loves this country, and gives his all for her benefit. You're the one who's crazy, refusing to back down."

Jools shook his head. "I got a green light. I'm a man of principle, not a fanatic. There's a big difference."

Olds flicked the gun's safety off. "Back down. Don't make me do this."

"I can't."

The barrel of the gun was just inches from Jools's forehead. Olds's voice rose to a wail. "*You're killing America!*"

Jools closed his eyes. He knew he should be feeling afraid, but only felt numb. SafeScan would save lives, and save them in a way the man who had forced him to develop it had never foreseen or intended. It would not be changed.

"*You're killing my country!*" Olds screamed one last time, this declaration followed by a single gunshot.

Jools jumped at the shot and flinched when blood splattered his face. He opened his eyes in time to see Olds crumple and fall to the floor. He sighed and wiped his face on his sleeve.

"And saving mine," he said. ■

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HOW NOT TO DO AETHER THEORY

As I write this, I have just passed the two-year anniversary of my departure from *Infinite Energy Magazine*. My time there was largely frustrating and unhappy, but I've spared my *Analog* readership the details. For the most part, I've adopted a live-and-let-live/let-sleeping-dogs-lie attitude toward the magazine. Yet now and then something comes up in *Infinite Energy* that bears on subject matter I've dealt with in this column, and I would be remiss not to comment upon it.

Recently, *Infinite Energy* editor Gene Mallove has been touting the work of Paulo and Alexandra Correa. He seems quite jazzed about it, going so far as to say: "From this time onward, any theorist who claims to have a comprehensive understanding of electromagnetism, mass, gravity, or thermodynamics had best be able to explain the thermal and electrical anomalies that were initially characterized by Reich, and which will be further elucidated in experiments by the Correas and others."[1] The "Reich" referred to is none other than Wilhelm Reich, the long-ago-discredited (fairly or not) proponent of "orgone" energy. (If you want to learn about orgone in detail, just do a web search on it—you'll likely find much more information than you care to.) In issue 37 of *Infinite Energy*, the Correas report that they replicated an experiment Reich showed to Albert Einstein (which they insist on calling the "Reich-Einstein experiment").[2] They claim that not only have they reproduced the "thermal anomaly" Reich claimed to have found, but also that they have refuted the mundane explanation of the anomaly offered by Einstein's assistant Leopold Infeld, which resulted in Einstein's subsequent loss of interest in the Reich-Einstein experiment.

The Reich-Einstein experiment itself is fairly simple. Reich suspended a Faraday cage (a Faraday cage is any volume enclosed by a conductor—just picture a hollow metal cube about a foot on each side for the rest of this article) in a room with a thermometer centered above and in near proximity to the top face. A second thermometer was suspended nearby and at the same height as the first. The "thermal anomaly" is simply that the thermometer over the Faraday cage measures a slightly higher temperature than the second thermometer. The conclusion of Reich and the Correas is that the Faraday cage is able to maintain this temperature difference by tapping into a previously unknown source of energy. Einstein seems to have also found this temperature difference when he did the experiment himself, reporting the "box temperature" as being about 0.3 to 0.4 degrees C higher than that of the freely suspended thermometer. However, Infeld suggested that there was nothing more surprising involved than the interaction of the box with convection air currents, and hence, no real anomaly after all.

The reasons why I'm spending my precious column inches on this subject are: (1) The Correas discuss their work

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at length at a site called *www.aetherometry.com*, "aetherometry" being "The science of the metrics of the aether." (2) I'm an aether theorist myself, as I've made plain in several columns. (3) Because of (2) and because of my previous association with *Infinite Energy*, some have asked me for my take on the Correas' work.

Well, I've been to their website and I don't understand a damn thing about what it is they say they're doing. They do use a lot of scientificky-sounding words, but, look—though I'm the kind of guy who reads graduate-level electromagnetism textbooks for fun, this background helps me not one wit in reading their material. They also seem hell-bent on inventing new words whether they need them or not. Of course, my inability to understand their work doesn't mean they're wrong—maybe they're just a lot smarter than the rest of us.

Let's return to the Reich-Einstein experiment. In their *Infinite Energy* piece, the Correas say they've proven that Infeld's explanation of the cause of the thermal anomaly doesn't hold up, because when they control for the effect of convection currents, the thermal anomaly remains.

Unlike my experience with their website, I do understand their *Infinite Energy* article, perhaps because my background is in experimental physics, and they do describe an experiment. One thing that is drilled into you when you learn how to be an experimental physicist (though seldom so succinctly) is this: "Seeing what you expect to see is *not* the same as finding what you expect to find." This just means that it's not good enough to have your experiment give you the results you expected; you also must rigorously show that some other effect isn't responsible for your results. Furthermore, every device or rig you design and build to measure a given phenomenon is, in and of itself, an experiment. In short, you have to experiment with your test rig to see what kinds of measurements it gives even when you're not trying to measure anything. This goes beyond simple calibration. Any given apparatus may have hidden couplings with itself or with the environment that are not easy to track down, let alone eliminate. What one tries to do is ascertain the magnitude of those effects on the measurement you're interested in making, so you can subtract them away to find the "real" value you're looking for. In the case of their Reich-Einstein experiment replication, the Correas seem to think that simply showing that Infeld's explanation was wrong somehow cinches their case that this is a true anomaly.

Well, not so fast. Even if we grant for the sake of argument that convection currents play no part in sustaining the temperature difference, there are other mundane sources of heat available.

Consider the Faraday cage for a minute. Faraday cages are typically used to isolate something on their inside from external radio "noise" of one sort or another. How do they do this? (1) Electrons in the walls of the Faraday cage get moved around by impinging EM fields (i.e. radio waves) (2) which results (more or less) in a cancellation of the wave field inside the box. (3) When electrons move in an imperfect conductor, they generate heat. (4) So any metal box anywhere, grounded or not, will be affected by the ambient EM environment. That is, all of the power wires, the radio transmitters, the TV transmitters, the 60-Hz AC wires in the walls, and so on, are emitting EM signatures that the walls of the Faraday cage will try to null out. In the process, this generates heat in the walls of the cage. Build the cage in the shape of a box, and this heat will dissipate both to the inside and the outside of the box. That heat going inward will eventually convect upward and you will get a hot spot in the center top.

How hot? Well, that depends on the nature of the box (the physical dimensions, the metal used, etc.) and on the

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local EM environment, which will change with time. For instance, my guess is that, in most places, the local EM noise level will go down at night since fewer people are using their cell phones, their lights, and their TVs.

This mundane EM noise heating effect is there in the Correas' boxes no matter where they put them (and it was there in 1941 when Reich showed this experiment to Einstein). The mere presence of this heat doesn't prove that it accounts for all of the reported temperature difference. But unless the Correas *do* take into account this heating due to the local environmental EM flux, either by direct measurement or rigorous calculation, there is no way to know what percentage of their heat signature is due to "aether energy" and what is simply due to EM noise.

The article lacked any such accounting. Worse than that, I searched in vain for any evidence of even the *recognition* that such a mundane source of heating is present. This is pretty sloppy. If the Correas can listen to a radio station in their lab, then their Faraday cages are also picking up that signal and turning it into heat. If they can tune in a hundred stations, then their Faraday cages are simultaneously moving electrons around to nullify all of those signals, and producing heat in the process. Granted, we ordinarily don't think about this source of "radiation" as contributing much to heat. But note that even a toy crystal radio set with no amplification or power circuitry at all and tuning in only one frequency from a distant radio station still outputs enough "oomph" to vibrate the diaphragm in an earphone. This not only brings music to your ear, but also warms up the diaphragm. A Faraday cage moves electrons around for all frequencies—weak, strong, high, low, it almost doesn't matter—and it does nothing with the signals except make heat.

Even though they didn't mention it, is there anything in the data they present that might rule out ambient EM as a significant source of heating? I'm afraid not. For the experiments they discuss, none of them show a mean temperature difference higher than about 0.3 C, and that ain't much, given the slack conditions under which these experiments were conducted. Their graphs also show a 24-hour rise-and-fall periodicity consistent with the expected rise and fall of the local ambient RF.

In an attempted replication of their work at the laboratory of *Infinite Energy* (NERL—New Energy Research Laboratory), Gene Mallove and Ken Rauen reported that: "Our laboratory has produced notably small temperature differentials in the Reich-Einstein experiment. This may be because of the metal roofing of our building acting as a shield, as a partial Faraday cage."[3] Yup. Put a Faraday cage inside another Faraday cage and the interior one won't have any local signals to null out, and hence, no temperature difference.

During my brief association with *Infinite Energy Magazine*, I only met Paulo Correa once, and that was merely elbow-rubbing, the simple result of the fact that we both spoke at the same symposium. Those who know him and his wife better than I are convinced of their integrity, and I see no reason to believe that they are deliberately trying to deceive anyone. Rather, I think they have fallen victim to the same bugaboo that catches many would-be paradigm shakers.

One must always be humble enough to realize that what looks like a mystifying anomaly to you, might be a well-understood phenomenon to someone else. To some, a unipolar motor is a mystery. To some, an electromagnet that will pick up a penny is unheard of. To some, magnetizing a block of wood is an impossibility. To me, all three of these are ordinary, all-in-a-day's-work, phenomena. (Okay, I haven't actually magnetized wood yet, but I know how it's done.)

In the case of the Reich-Einstein ex-

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periment, most would expect no temperature differential at all. So when the experiment is replicated, and a real temperature difference appears, it is all too easy for the experimenter, having seen what he hoped to see, to accept as true the explanation put forward by Reich. It takes training to know *how* to look for other explanations. And it takes a kind of reluctant courage to force yourself to do that looking, especially when you think you've found what you wanted to find. ■

References

[1] This is from the editorial of issue number 37 of *Infinite Energy Magazine*, published by Cold Fusion Technology, Inc. Their website is *www.infinite-energy.com*.

[2] The title of the article is "The Reproducible Thermal Anomaly of the Reich-Einstein Experiment Under Limit Conditions," by Paulo N. Correa and Alexandra N. Correa.

[3] This is from the Device Updates section of issue number 42 of *Infinite Energy*. Current and past Device Updates are also available online at the website.

IN TIMES TO COME

Back in April 1999, Daniel Hatch introduced us to Chamal, a world whose whole ecosystem runs on a fundamentally different genetic mechanism from ours. Rules of inheritance and relationships among species are wildly different from those on Earth; in fact, the very concept of "species" finds this turf too slippery to gain much traction. In "Seed of Reason," neither the natives nor human visitors really understood how the system worked, though some were trying. Next month, in "Seed of Destiny," one man has made a breakthrough—but so have some of the locals. They have begun to see how the system limits them, and a way to defy those limits; but they need help—whether that man wants to give it to them or not!

Our January 2003 issue will also feature a potpourri of stories by such writers as Rajnar Vajra, Kyle Kirkland, and Larry Niven; and Yoji Kondo's science fact article on Kepler Mission, a real-world project to discover Earthlike planets around other stars.

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You Gotta See This!

Ian Randal Strock

I guess you could call us a bunch of practical jokers. Our wives usually call us bums, our bosses call us roughnecks, and reporters—when they talk about us—spacejacks.

Building Artemis City ain't the easiest job we've ever had, but it can be interesting. And working in a low-g, no-air environment sure opened things up for some new practical jokes.

Like the time Benny smeared that real smelly cheese in Artie's air hose: Artie wasn't none too happy that night.

Or when Stu got on the radio and made like he was from Alpha Centauri; near to scared Bobby outta his suit.

Anyway, we was all enjoying ourselves—working hard, as always—when Greg gets this idea. "Why keep joking each other? We're up here, looking down on the world," Earth is always the world, to us, "and there ain't much they can do to us. We oughta come up with the joke to end all jokes . . . on them."

Well, I didn't know what the joke was, but I knew it was a good idea, and I said so.

Then Joey comes along. Joey's always got the weirdest jokes. Sometimes they ain't any good, but he's more creative than the rest of us put together.

"Joey," Greg says, "what's the best way we can joke the whole world at once?"

Joey's face goes blank, so we know he's deep in thought.

"There's gonna be an eclipse of the Sun on August 21st." We have no idea how he knows this stuff. "It'll be visible all across the States. That'd be the best time to do it, 'cause everyone will be looking up here."

"Do what?" asks Artie.

"Well, we've got all these solar furnaces, right?" The solar furnaces are big kettles with fresnel lenses on top; we use 'em to melt rocks. Anyway, Joey says, "We gotta turn the lenses over. They won't be any good for melting

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rocks like that, but we can put 'em back again after the joke."

"Yeah, we could do that," says Stu, "but why?"

But Joey's back to thinkin'. "And we gotta coat the insides of the furnaces with steel. Real shiny, like mirrors."

Bobby's the smelting expert. "Okay, coat the insides with high-gloss steel. Yeah, we can do that in like a day. Might not last too long, though."

"That's fine," says Joey.

Now we're gettin' into it, but he still hasn't told us what the gag is gonna be.

"A light source," he starts muttering. "We need a really bright light. Seven of them."

I figure that means one for each of us.

"The landing lights," I say. They're my department. "There won't be any ships coming in between now and the 21st, anyway, right Benny?"

Benny's the guy who keeps track of schedules. "Nope. Next one's not due in 'til the 26th."

"Okay," says Joey. "Now we're cooking. Power for the lights?"

"They're plugged into the grid," says Artie, the power boss.

"Sure, they are now," says Joey. "But they're each going to need an independent power source for this to work. No way we're laying a thousand miles of power cables to pull off this gag."

"Huh?" someone asks.

"There's seven of us, which means we'll have to make due with seven points. One furnace and one light each. Each one of us is going to need a battery, Artie."

"We've still got those RTGs collecting dust. Use 'em?"

"You'll have to ramp up the power output a bit. But they ought to work."

And then we get busy. Coating the furnaces and switching the lenses are easy, but putting the lamps in and wiring them up takes a bit more work.

So anyway, we finish our super-sized flashlights, and Joey's got this map out, all marked up with tracks and seven Xs. "We need one of us at each of those spots. I've mapped out paths that the surface buggies can handle for each of us. We'll have to synchronize our watches so that we all turn them on at the same instant."

And looking closer at the map, we see the layout of the seven points.

"A smiley face?" I ask Joey.

"Hey, everyone's gonna be looking. And when I switch my light off and on, we'll be smiling and winking at the world."■

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Human creations sometimes find uses other than the ones they were designed for. . . .

VOICES

Charles L. Harness

The man had come up into the attic in search of a last-minute star for the top of the tree. He didn't think he would find it. He didn't believe he had stored it here. But she had insisted that he look, and it was best to humor her. She had fully recovered from her surgery but she still had to contend with radiation and hair loss, and they still slept in separate beds. He needed to say something, do something. But what? He shook his head and pulled the cord for the attic lights and looked around.

Some of the boxes were tied with string and labeled in her delicate handwriting. None of those. Moving on down. Ancient holo, obsolete computer, autophone. All mantled with dust. Books, family memorabilia. Toys. He stopped. Maybe it had gotten mixed in . . . Let's see. Take a look at the top box. Lid just folded over . . . not tied up . . . not taped. Could be.

Well, look at this. Toy soldier? No, he remembered now. A cowboy. Packed in with a girl doll. He had gotten them for his son. The boy—now grown up and gone away. Ah, takes me back. Let's get them out, take a closer look.

The cowboy was about twelve inches tall, the girl a little less. There had once been a horse for the cowboy, but it had long vanished into the rough-and-tumble play of boyhood. Only a very beat-up saddle was left. The girl had endured even worse usage. She had no almost no hair. Her skull had been stripped nearly bare. As if to accentuate the lack, a miniature comb was stuck in the last forlorn strand.

The man considered the pair curiously. He picked up the cowboy doll, turned it over, felt between the shoulder blades, found the switch. He hesitated, then flipped the switch. After a moment the doll's eyes lit up. My goodness, thought the man. After all this time. Eternies—great batteries!

Let's see. Tex. We called you Tex. He laid the doll aside, picked up the girl,

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pressed a switch on her back. Her eyes lit up. Marie. Of course.

He tried to think back. How long ago had he and his son used the dolls in a play? That had been a lot of fun. Those plays . . . you would feed the little mannequins a scene, a few lines, and they would take it from there. Given a suitable story line, they could produce some odd twists. They had brains the size of walnuts, but packed with several billion microtransistors. They were immobile but could see, hear, talk. They were in effect talking heads. Now long obsolete, replaced by mobile life-sized humanoid robots. Still, in their day, Tex and Marie had been his son's most cherished toys.

He placed them on the floor facing each other. Does it still work? he wondered. What can we conjure up? He recalled past scenarios, with Marie on a runaway horse, her golden hair flying, and Tex racing to the rescue. Or that scene where Marie is held hostage by the bad guys, her hair gleaming in the campfire, and Tex comes galloping up. All by audio, of course. Nothing really moving. You used your imagination. But it seemed to work.

He thought a moment. What story line could these two come up with? It would have to take into account that Tex had no horse and Marie had no hair. Hardly fair. The dolls might declare data error and refuse to play. Still, in the past the programmers had shown considerable ingenuity. So let's see.

He said quietly, "Tex, Marie . . . do you hear me?"

After a moment he heard the whispery voices. "We hear you."

He said, "Look her over, Tex. And you take a good look at him, Marie. You've got this beat-up saddle, Tex, but no horse. And Marie, you have this ornamental plastic comb, but no hair." He studied them thoughtfully. "Here's the story. You two are deeply in love. The year is 1890 . . . in Fort Worth . . . it's Christmas." He paused. "Gifts . . . you should exchange gifts. Your own ideas . . . decide as you go along. Give me a running account."

After a moment the girl doll spoke in a tiny voice. "Me first? Okay, I take him by the arm. I say, *C'mon, I want to show you something. It's in the barn."*

Tex now speaks in thin reedy tones: *"But . . . I . . ."*

Marie said, "I pull him along the snow-dusted path, I open the barn door. We are inside. *Voilà!* I declare. It's his old saddle, but obviously it has been repaired and refinished."

Tex speaks now. "I approach, examine it in awe. I run my hand over the leather. *Real pigskin?* I mutter."

Marie: *The finest Mexican leather.... all completely rebuilt.*

Tex: *And bigger? The skirt is measured to fit Ranger?*

Marie: *He's a big horse. Where is he?*

Tex: *And wow, look at this . . . stirrups, horn, cinch ring . . . all silver!*

Marie: *Merry Christmas, darling!*

Tex: I gurgle something, grab her, hold her. Eventually she disengages.

Marie: *You want to try it out on Ranger? Where is he?*

Tex: *Uh . . . Ranger . . . I . . . ah . . . lent him to . . . Murphy.* I take a deep breath. *But never mind that.* I pull a small flat package from the depths of my jacket and hand it to her.

Marie: I hold the package for a moment.

Tex: *Well, I guess you'd better open it?*

Marie: *Yes.* With deft motions of my hands and fingers I untie the ribbons.

Tex: Meanwhile I have been examining her head, which is wrapped in a turban which completely conceals her long beautiful hair.

Marie: I pause, look up, smile uncertainly, then I open the box. I gasp. The comb is dazzling.

Tex: I say modestly, *The little stones, real diamonds.* Meanwhile I am running my hands along the back of her neck. I add evenly, *Marie, what hap-*

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pened to your hair?

Marie: I cannot reply. I bury my face in his chest.

Tex: *You sold it? Your beautiful golden hair? To pay for the saddle?*

Marie: I nod, and whisper, *It'll grow back* . . . After a time I look up. I have a sudden insight. *Where'd you get the money for my comb?*

Tex: I am silent.

Marie: *You sold Ranger.*

Tex: No reply.

Marie: *Oh. Tex! You magnificent idiot! How could you?*

Tex: *Because you are absolutely the most beautiful woman I have ever met and I love you very much.* I pick her up, carry her out of view. I whisper, *Merry Christmas, darling.* The action fades.

The lights in the doll-eyes dimmed, went dark, and there was silence.

The man sat there a long time, thinking. Neither horse nor hair, just each other. Sounds like something out of 0. Henry. Hmm. He packed the dolls away, got up slowly, turned off the light.

She was waiting for him at the foot of the stairs. She could see that he didn't have the tree ornament.

He sat down on the top stair and looked down at her.

"What?" she said, looking up, puzzled.

"I just wanted to say . . ."

She frowned and adjusted her spectacles.

He smiled. "Just wanted to say I think you are absolutely the most beautiful woman I have ever met and I love you very much." He started down the stairs.

She began to blush. With nervous fingers she adjusted her wig.

As he lifted her up in his arms he whispered, "Merry Christmas, darling."■

I must create a system or be enslaved by another man's.

—William Blake

After you see something work, then you realize that it's not so complicated after all.

—J. Franklin Hyde

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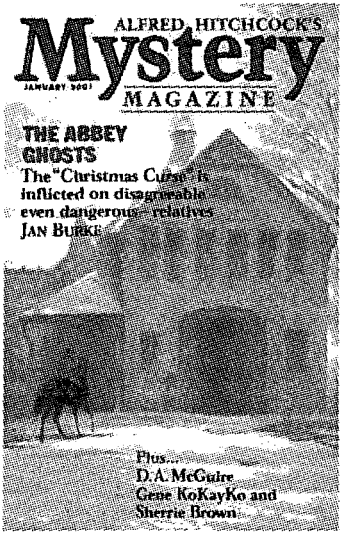
SOME PEOPLE WOULD KILL...FOR A COPY



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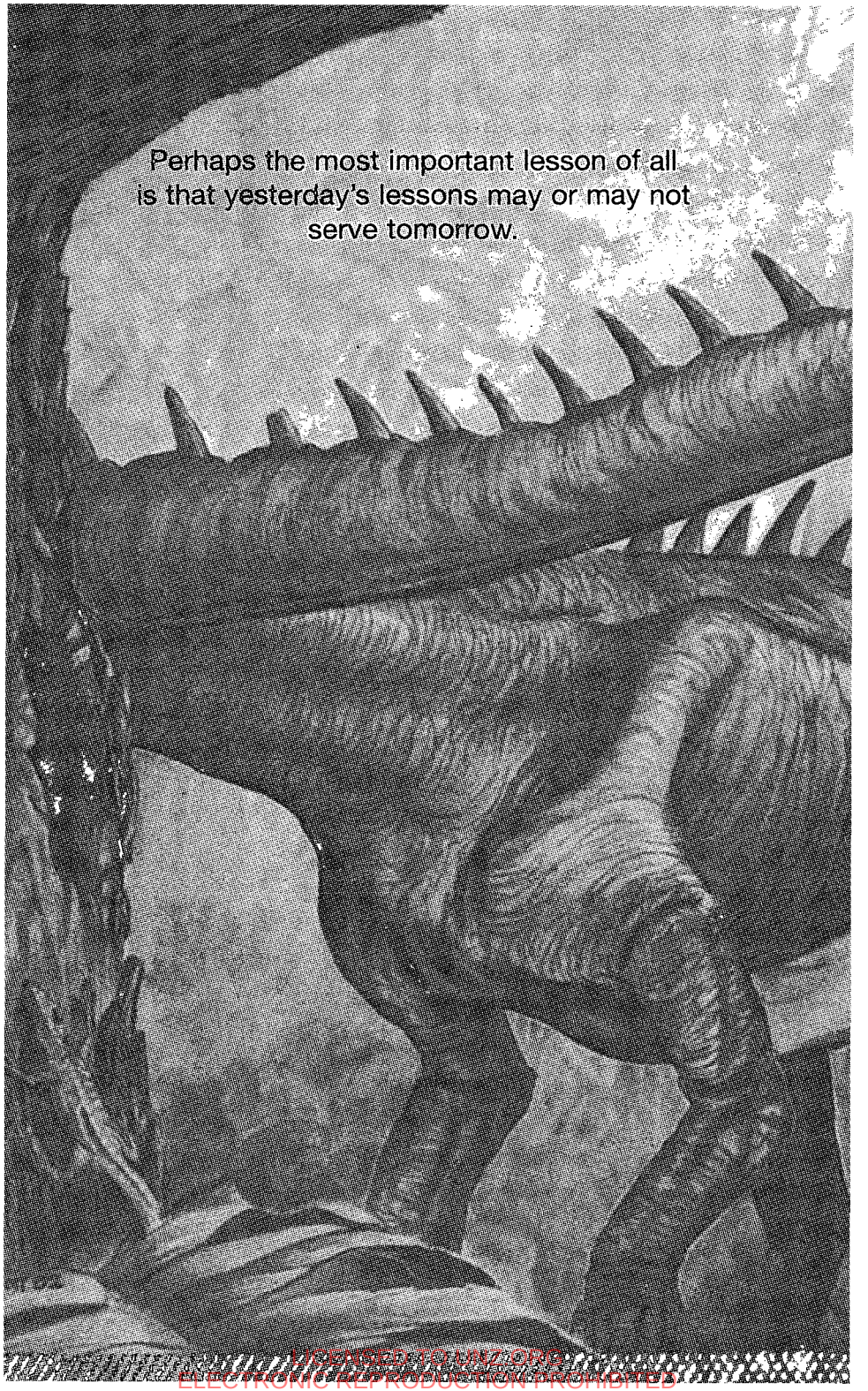

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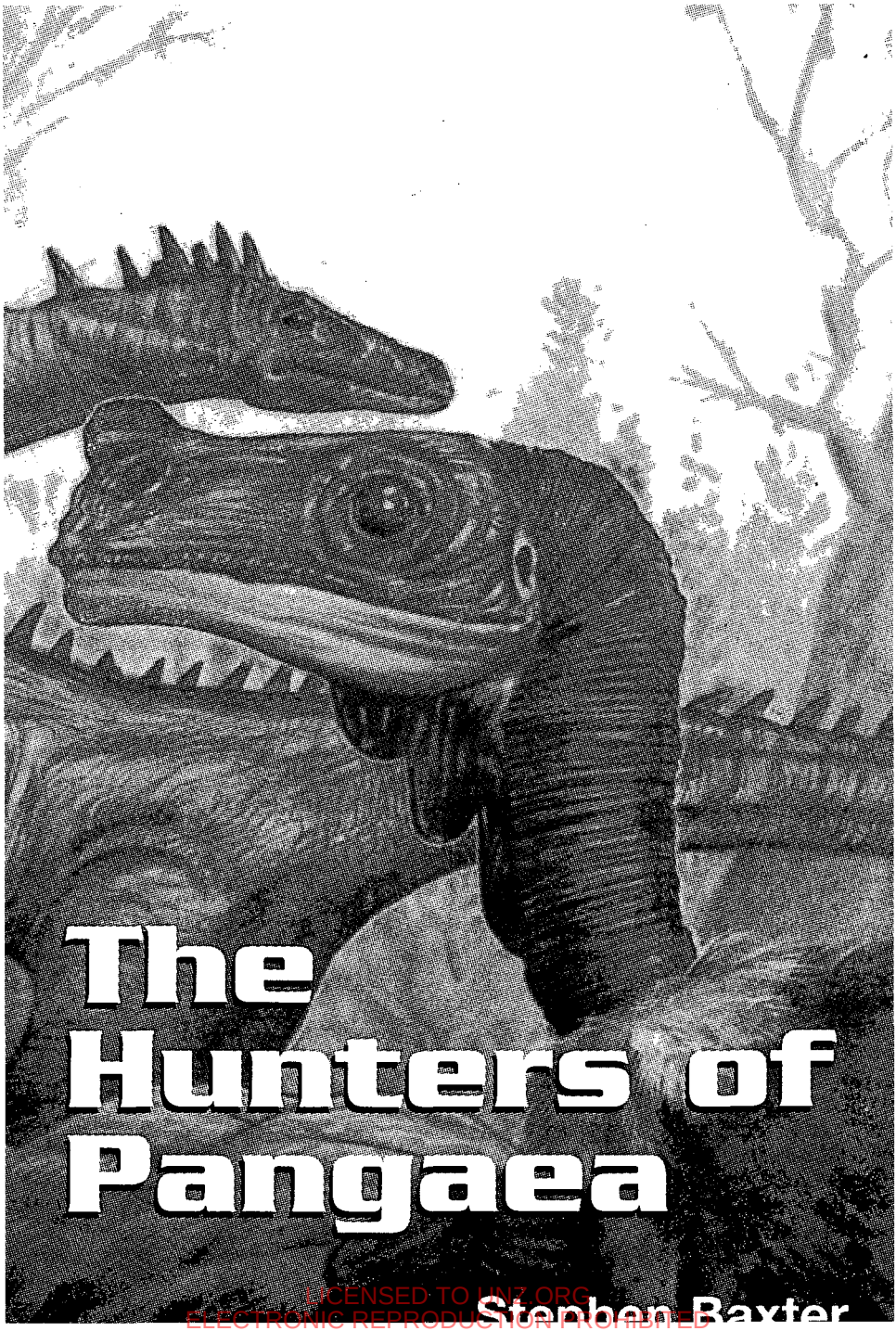

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An ornitholestes stalked through the dense Jurassic forest, hunting diplodocus.

This ornith was an active, carnivorous dinosaur. She was about the height of an adult human, but her lithe body was less than half the weight. She had powerful hind legs, a long, balancing tail, and sharp conical teeth. She was coated in brown, downy feathers, a useful camouflage in the forest fringes where her kind had evolved as hunters of carrion and eggs. She was like a large, sparsely feathered bird.

But her forehead might almost have been human, with a high skull cap that sat incongruously over a sharp, almost crocodilian face.

Around her waist was a belt and a coiled whip. In her long, grasping hands she carried a tool, a kind of spear.

And she had a name. It would have translated as something like Listener—for, although she was yet young, it had already become clear that her hearing was exceptional.

Listener was a dinosaur: a big-brained dinosaur who made tools, and who had a name.

No human would ever know she had existed.

Listener was first to hear the approach of the diplo herd. She felt it as a gentle thrumming in her bones. She immediately dropped to the ground, scraping away ferns and conifer needles, and pressed her head against the compacted soil.

The noise was a deep rumble, like a remote earthquake. It was the deepest voices of the diplos—what Listener thought of as belly-voices, a low-frequency contact rumble that could carry for kilometers.

The diplo herd must have abandoned the grove where it had spent the chill night, those long hours of truce when hunters and hunted alike slid into dreamless immobility. It was when the harass the herd, perhaps to pick off a vulnerable youngster or invalid.

Listener's mate watched her. He was called Stego, for he was stubborn, as hard to deflect from his course as a mighty—but notoriously tiny-brained—stegosaur.

He asked, *They are moving?*

Yes, she replied. *They are moving.*

Hunting carnivores were accustomed to working silently. So their language was a composite of soft clicks, hand signals and a ducking body posture—no facial expressions, for the faces of these orniths were as rigid as any dinosaur's.

Listener and Stego slid silently through the green shade of the forest fringe, moving with an unspoken coordination that made them look like two halves of a single creature. For generations, reaching back to the red-tinged mindlessness of their ancestors, this species of carnivore had hunted in mating pairs, and so they did now.

The forest was dominated by tall araucaria and ginkgoes. In the open spaces, there was a ground cover of ferns, saplings and pineapple-shrub cycadeoids. But there were no flowering plants. This was a drab, unfinished-looking world, a world of gray-green and brown, a world without color, through which the hunters stalked.

As they approached the herd, the noise of the great animals' belly-voices became obvious. It made the very ground shake: the languid fronds of ferns vibrated, and dust danced up, as if in anticipation. And soon the orniths could hear the footfalls of the mighty animals, tremendous, remote impacts that sounded like boulders tumbling down a hillside.

The orniths reached the very edge of the forest. And there, before them, were the diplos.

When diplodocus walked, it was as if the landscape was shifting, as if the hills had been uprooted and were moving

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er might have found it difficult to comprehend what she saw. The *scale* was wrong: surely these sliding great masses must be something geological, not animal.

The largest of this forty-strong herd was an immense cow, a diplo matriarch who had been the center of this herd for over a century. She was fully thirty meters long, five meters tall at the hips, and she weighed twenty tonnes—but then, even the youngsters of the herd, some as young as ten years old, were more massive than the largest African elephant.

The matriarch walked with her immense neck and tail held almost horizontal, running parallel to the ground for tens of meters. The weight of her immense gut was supported by her mighty hips and broad elephantine legs. Thick ropelike ligaments ran up her neck, over her back and along the tail, all supported in canals along the top of the backbone. The weight of her neck and tail tensed the ligaments over the neck, thereby balancing the weight of the torso. Thus she was constructed like a biological suspension bridge.

The matriarch's head looked almost absurdly small, as if it belonged to another animal entirely. Nevertheless, this was the conduit through which all her food had to pass. She fed constantly, her powerful jaws capable of taking bits out of tree trunks, huge muscles flowing as the low-quality food was briskly processed. She even cropped in her sleep. In a world as lush as this late Jurassic, finding food wasn't a problem.

Such a large animal could move only with a chthonic slowness. But the matriarch had nothing to fear. She was protected by her immense size, and by a row of toothlike spines and crude armour plates on her back. She did not need to be smart, agile, to have fast reactions; her small brain was mostly devoted to the biomechanics of her immense body, to balance, posture and movement. For all her bulk, the matriarch was oddly graceful. She was a twenty-tonne ballerina.

As the herd progressed, the herbivores snorted and growled, lowing irritably where one mighty body impeded another. Under this was the grinding, mechanical noise of the diplos' stomachs, and around the diplos' rumps, cloudy farts erupted into the air. Rocks rumbled and ground continually within those mighty gizzards to help with the shredding of material, making a diplo's gut a highly efficient processor of the variable, low-quality fodder that was barely chewed by the small head and muscleless cheeks. It sounded like heavy machinery at work.

Surrounding this immense parade were the great herbivores' camp followers. Insects hovered around the diplos themselves and their immense piles of waste. Through their swarms dove a variety of small insectivorous pterosaurs. Some of the pterosaurs rode on the diplos' huge uncaring backs. There was even a pair of ungainly, chicken-flapping protobirds, running around the feet of the diplos, snapping enthusiastically at grubs, ticks and beetles. And then there were the carnivorous dinosaurs, who hunted the hunters in turn. Listener spotted a gaggle of juvenile coelurosaurs, gamely stalking their prey among the tree-trunk legs of the herbivores, at every moment risking death from a carelessly placed footfall or tail twitch.

It was a vast, mobile community, a city that marched endlessly through the world-forest. And it was a city of which Listener was part—a city where she had spent all her life, where she would stay until she died.

Now the diplo matriarch came to a grove of ginkgoes, quite tall, ripe with green growth. She raised her head on its cable neck for a closer inspection. Then she dipped her head into the leaves and began to browse, tearing at the leaves with her stubby teeth. The other adults joined her. The animals began simply to

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barge down the trees, snapping trunks and even ripping roots out of the ground. Soon the grove was flattened; it would take decades for the ginkgoes to recover from this brief visit.

Thus the diplos shaped the landscape. They left behind a great scribble of openness, a corridor of green savannah in a world otherwise dominated by forest, for the herd so ravaged the vegetation of any area that it had to keep moving, like a rampaging army.

This loose herd had been together—traveling forever east, its members changing, its structure continual—for *ten thousand years*.

But there was room for such titanic journeys.

Jurassic Earth was dominated by a single immense continent: *Pangaea*, which meant 'the land of all Earth.' It was a mighty land. South America and Africa had docked to form a part of the mighty rock platform, and a titanic river drained the heart of the supercontinent—a river of which the Amazon and Congo were both mere tributaries.

In the deeper past, as the continents had coalesced and Pangaea was born, there had been a great pulse of death. The removal of barriers of mountain and ocean had forced species of plants and animals to mix; and the specialists, the less well-adapted, could not survive. And then the supercontinent's interior had at first dried out to an intensely arid desert; and a great global warming pulse had reduced further the opportunities for different kinds of life.

Only a handful of animal species had survived the great joining: insects, amphibians, reptiles—and protomammals, reptilian creatures with mammalian features, a lumpen, ugly, unfinished lot. But, in the long run, that had been enough. That handful of species would ultimately give rise to all the mammals—including humans—and to the great lineages of birds, crocodiles and dinosaurs.

But still for long ages the simple geometry of the supercontinent dominated life on Earth. In the time of Listener, a uniformity of flora and fauna sprawled across all of Pangaea, from ocean to ocean, pole to pole—a uniformity sustained even though vast tectonic forces were already laboring to shatter the immense landmass.

As if in response to the vast landscape in which they found themselves, the diplos had grown huge. Certainly their immensity was suitable for these times of unpredictable, mixed vegetation. With her long neck, a diplo could work methodically across a wide area without even needing to move, taking whatever ground cover was available, even the lower branches of trees.

These were not the mightiest herbivores—that honor went to the giant, tree-cropping brachiosaurs, who could grow as massive as seventy tonnes—but the brachiosaurs were solitary, or moved in small groups. The diplos' mighty herds, sometimes a hundred strong, had shaped the land as no animal had before or since.

In the clever orniths the diplos faced a new peril, a danger for which evolution had not prepared them. Nevertheless, after more than a century of life, the matriarch had absorbed a certain deep wisdom, and her eyes, deep red with age, betrayed an understanding of the lithe horrors that pursued her kind.

Now the patient orniths had their best opportunity.

The diplos still crowded around the wrecked ginkgo grove, their great bodies in a starburst formation. Their heads on their long necks dipped over the scattered foliage like cherry-picker mechanical claws. Youngsters clustered close, but for now they were excluded by the giant adults.

Excluded, forgotten, exposed.

Stego ducked his head towards one of the diplo young. She was a little smaller than the rest—no larger than the largest African elephant, a genuine runt. She

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was having trouble forcing her way into the feeding pack, and she snapped and prowled at the edge of the formation with a massive birdlike twitchiness.

It looked as if this runty female would pay the price on behalf of the rest.

There was no real loyalty among the diplos. The herd was a thing of convenience, not a family grouping. Diplos laid their eggs in the edge of the forest, and then abandoned them. The surviving hatchlings would use the cover of the forest until they had grown sufficiently massive to take to the open land and seek a herd.

The herds made strategic sense: diplos helped protect each other by their presence together. And any herd needed new blood for its own replenishment. But if a predator took one of the young, so be it: in the endless Pangaean forests, there was always another who would take her place. It was as if the herd accepted such losses as a toll to be paid for its continuing passage through the ancient groves.

Listener and Stego took their whips of diplo leather from around their waists. Whips raised, spears ready, they crept through the rough scrub of saplings and ferns that crowded the edge of the forest. Even if the diplos spotted them, they would probably not react; the diplos' evolutionary programming contained no alarm signals for the approach of two such diminutive predators.

A silent conversation passed in subtle movements, nods, eye contacts.

That one, said Stego.

Yes. Weak. Young.

I will run at the herd. I will use the whip. Try to spook them. Separate the runt.

Agreed. I will make the first run on the runt. . . .

It should have been routine. But as the orniths approached, coelurosaurs scuttled away, and pterosaurs flapped awkwardly into the air.

Stego hissed. Listener turned.

And looked into the eyes of another ornith.

There were three of them, Listener saw. They were a little larger—and therefore probably older—than Listener and Stego. They were handsome animals, each with a distinctive crest of spiny decorative scales running down the back of the head and neck; Listener felt her own spines rise up in response, her body obeying an unbidden, ancient instinct.

But these orniths were naked. They had no belt of woven bark around their waists, like Listener's; they carried no whips, no spears, and their long hands were empty. They did not belong to Listener's hunting nation, but were her remote cousins—wild orniths—the small-brained stock from which her kind had arisen.

She hissed, her mouth gaping wide, and strode into the open. *Get away! Get out of here!*

The wild orniths stood their ground. They glared back at Listener, their own mouths gaping, heads bobbing.

A tinge of apprehension touched Listener. Not so long ago, three like these would have fled at her approach; the wild ones had long learned to fear the sting of weapons wielded by their smarter cousins. But hunger outweighed their fear. It had probably been a long time since these brutes had come across a diplo nest, their primary food source. Now these clever opportunists probably hoped to steal whatever Listener and Stego managed to win for themselves.

The world-forest was getting crowded.

Listener, confronted by this unwelcome reminder of her own brutish past, knew better than to show fear. She stalked steadily towards the three wild orniths, head dipping, gesturing strongly. *If you think you are going to steal my kill you have another think coming. Get out of here, you animals. Get*—out.

But the mindless ones replied with hisses and spits.

The commotion was beginning to dis-

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tract the diplodocus. That runty female had already ducked back into the mass of the herd, out of reach of the hunters. Now the big matriarch herself looked around, her head carried on her neck like a camera platform on a boom crane. She lowed in irritation at the nonsensical antics of the squabbling orniths.

It was the chance the allosaurs had been waiting for.

The allos stood like statues in the forest's green shade, standing upright on their immense hind legs, their slender forearms with their three-clawed hands held beneath. This was a pack of five females, not quite fully grown—but nevertheless each of them was ten meters long, and weighed more than two tonnes.

Allosaurs were not interested in runtish juveniles. They had targeted a fat male diplo, like themselves just a little short of full maturity. As the herd milled, distracted by the commotion of the squabbling orniths, that fat male got himself separated from the protective bulk of the herd.

The five allos attacked immediately, on the ground, in the air. With hind claws like grappling hooks, they immediately inflicted deep, ugly wounds. They used their strongly-constructed heads like clubs, battering the diplo, and teeth like serrated daggers gouged at the diplo's flesh. Unlike tyrannosaurs, they had big hands and long, strong arms they used to grab onto the diplo while dismembering him. The diplo, slowly understanding he was under attack, stumbled and tried to turn.

It was a scene of immense and ferocious carnage. Allosaurs were the heaviest land carnivores of all time. They were like upright, fast-running elephants attacking a wall of meat.

Meanwhile, the diplo herd was fighting back. The adults, bellowing in protest, swung their huge necks back and forth over the ground, hoping to sweep aside any predator foolish enough to come close. One of them even reared up on her hind legs, a vast overpowering sight.

And they deployed their most terrible weapon. Diplo tails lashed, all around the herd, and the air was filled with the crackle of shock waves, stunningly loud. A hundred and forty-five million years before humans, the diplos had been the first animals on Earth to break the sound barrier.

The allosaurs had expected this. They retreated quickly. Nevertheless one of them was caught by the tip of a supersonic whip-tail that crashed into her ribs. Allosaurs were built for speed and their bones were light; the tail cracked three ribs, which would trouble the allosaur for months to come.

But the attack, in those few blistering moments, had been successful.

Already one great leg had collapsed under the male diplo, its ripped tendons leaving it unable to sustain its share of the animal's weight. Soon his loss of blood would weaken him further. Though he raised his head and honked mournfully, the herd was already turning away.

It would take hours yet for him to die—the allosaurs, like most clever carnivores, liked to play—but his life was already over.

Gradually the crackle of whiplash tails ceased, and the herd grew calmer.

But it was the big matriarch who delivered the last whiplash of all.

When the allosaurs had attacked, the orniths, suddenly united in terror, had fled the clearing. Now Listener and Stego skulked side by side in the forest-edge scrub, their unused weapons in their hands, their hunt thwarted. But it wasn't all bad news. When the allos were done feeding, there might be meat to be scavenged from the fallen diplo—

Then came that last whiplash. The huge tail landed clean across Stego's back, laying his skin open to the bone. He screamed and fell, tumbling out into the open, his mouth agape. The slit pupils in his eyes pulsed as he gazed up

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at Listener.

Listener stood stock still, shocked.

And one of the allosaurs, not far away, turned with glassy interest. With a single bound, she reached Stego.

Stego screamed and scrabbled at the mud, as if seeking to escape into the body of the Earth. The allo poked him curiously, almost gently, with her muzzle. Listener couldn't move.

Then, with astonishing speed, the allo's head shot forward and delivered a single clean bite, all but severing Stego's neck. She grabbed him by the shoulder, lifting him high. His head dangled by a few threads of skin, but his body twitched still. She carried him to the edge of the forest, away from the herd, where she began to feed. The process was efficient. The allo had joints within her jaw and skull, so that like a python she could open her mouth widely and position her teeth, the better to consume her prey.

Listener found herself staring stupidly at an allosaur track, a three-toed crater firmly planted in the trampled mud. *A hunter without her mate is like a herd without its matriarch*: an ornith proverb that sounded in her head, over and over.

The big matriarch diplo had swung her head around on its great boom-crane neck. And she stared directly at Listener. Listener understood. The ornithes' antics had given the allos their chance to attack. So, with her whiplash, the matriarch had exposed Stego. She had given him to the allos.

It had been revenge.

The matriarch turned away, lowing, as if contented.

Something hardened, a dark core, in Listener's mind.

She knew she would spend the rest of her life with this herd. And she knew that the matriarch was its most important individual: providing protection to the rest with her sheer bulk, leading them with her wisdom acquired over long years. Without her, the herd would be much less well coordinated, much more under threat. In a way, this matriarch was the most important individual creature in Listener's life.

But in that moment, she swore vengeance of her own.

Each night, the orniths retreated to their ancestral forest, where once they had hunted mammals, insects and the nests of diplodocus. They scattered in little pockets, and surrounded the area with heavily armed sentries.

That evening, the mourning was extensive. This ornith nation was only a few hundred strong, and could ill afford to lose a strong, intelligent young male like Stego.

Even as the cold of night drew in, Listener found it hard to rest.

She roamed the loose encampment. She passed groups of play-wrestling young, and a few elderly hunters who had already huddled into statuesque sleep. Two young males were working on diplo leather, grinding and pulling it between their teeth and hammering it with stones. As they worked, they communicated in body language, the one telling the other an outlandish story of a spectacular mating.

Further on, Grasper was making a spear-thrower before a clutch of youngsters. Grasper was old now, and with one leg badly crushed by a diplodocus's careless turn, and he was no longer an effective hunter; but he earned his place and his share of meat with his expertise at toolmaking. For the benefit of the youngsters he demonstrated the thrower's intricate construction, from bits of araucaria wood and creepers from epiphytic ferns. Grasper greeted Listener, once a favoured pupil herself, and bade her join the group.

But the young apprentices were restless. Toying with the tiny whips wrapped around their waists, they were squabbling over the remains of a meter-long diplodocus embryo.

Here was One-Eye, a storyteller who

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held his little audience rapt with a performance delivered in snaps, grunts, eye rolling and subtle body movements. One-Eye told tales of the Playful One: neither male nor female, as strong as any two hunters put together, who, after death, would welcome orniths into a kind of paradise where the diplos were tailless and infinitely tall, and where the forests went on forever.

The stories entranced the young and old alike. Every species capable of making multicomponent tools understood causality, and therefore sought explanations for the wider universe: the Playful One was Earth's first god.

But One-Eye's tales of antics in a bloody heaven brought Listener no comfort.

She gazed up at a sky across which auroras flapped, steep three-dimensional sculptures of light, green and purple. In this age, Earth's magnetic field was three times its strength in the human era, and, as it trapped the wind streaming from the Sun, the shining auroras would sometimes blanket the planet from pole to pole.

She sought refuge in memories of happier, simpler times when she and Stego, emulating their distant ancestors, had hunted for diplo eggs.

The trick was to seek out a patch of forest floor, not too far from the edge, that looked apparently lifeless, strewn with leaves and dirt. If you put your sensitive ear to the ground, you could hear, if you were lucky, the telltale scratching of diplo chicks in their eggs. Listener had always preferred to wait, to guard "her" nest from others, until the diplo chicks began to break out of their eggs and stick their tiny heads out of the scattered dirt.

For an inventive mind like Listener's, there was no end to the games you could play.

You could try to guess which chick would come up next. You could see how quickly you could kill a new emergent, snuffing it out within a heartbeat of its first glimpse of daylight. You could even let the chicks come out of their shells altogether. Already a meter long, with their flimsy tails and necks dangling, the chicks' only priority was to escape to the deeper forest, where, their innate programming told them, shelter could be had. You could let a chick get all the way to a patch of scrub—almost, and then haul it back. You could pick it up and dump it on the open ground beyond the forest, and see it scrabble blindly to get back. You could nip off its legs one by one, or bits of his tail, and, crunching the little morsels, see how it still struggled, as long as its brief life lasted, to get away.

All smart carnivores played. It was a way of learning about the world, of how prey animals behaved, of honing reflexes.

For their time, orniths had been very smart carnivores indeed.

Once, not more than twenty thousand years ago, a new game had occurred to one of them. She had picked up a handy stick in her grasping hand, and she used that to probe for unbroken eggs.

By the next generation, the sticks had become hooks to drag out the embryos, and sharpened spears to stab them.

And by the next, the embryonic weapons were being trialed on bigger game: juvenile diplos, younger than five or six years, not yet part of a herd but already a meat haul worth hundreds of embryonic chicks. Meanwhile, a rudimentary language was born, of the subtle communications of pack hunters.

A kind of arms race followed. In this age of immense prey, the orniths' better tools, more sophisticated communication and complex structures were quickly rewarded by bigger and better hauls of meat. Ornith brains rapidly expanded, the better to make the tools, and sustain societies, and process language—but there was a need for more meat to feed the big expensive brains, requiring better tools yet. It was a virtuous spiral that

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would operate again, much later in Earth's long history.

After that, the orniths had spread all over Pangaea, following their prey herds as they criss-crossed the supercontinent along their vast ancestral corridors of parkway.

But now conditions were changing.

Pangaea was breaking up, its backbone weakening. Rift valleys, immense troughs littered with ash and lava, were starting to open. New oceans would be born in a great cross shape: eventually the Atlantic would separate the Americas from Africa and Eurasia, while the mighty equatorial Tethys would separate Europe and Asia from Africa, India, Australasia. Thus Pangaea would be quartered. It was a time of rapid and dramatic climate change. The drift of continental fragments created new mountains which in turn cast rain shadows across the lands; the forests died back, and immense dune fields spread.

Generation by generation—as their range disintegrated, and the vegetation no longer had time to recover from their devastating passage—the great sauropod herds were diminishing.

Still, if not for the orniths, the sauropods might have lingered much longer, even surviving into the great high summer of dinosaur evolution, the Cretaceous.

If not for the orniths.

Though Listener went on to take more mates, and to raise proud clutches of healthy and savage young, she never forgot what had become of her first mate, Stego.

Listener did not dare challenge the matriarch. Everyone knew that the best chance of the herd's survival was for the powerful old female to continue her long life; after all, no new matriarch had emerged to replace her. But, slowly and surely, Listner drew up her plans.

It took her a decade. Over that time the numbers of diplos in the herd halved. The allosaurs too went into steep decline across the supercontinent as their prey animals became scarce.

At last, after a particularly harsh and dry season, the old one was observed to limp. Perhaps there was arthritis in her hips, as there evidently was in her long neck and tail.

The time was close.

Then Listener smelled something in the wind from the east, a taste she had not known for a long time. It was salt. And she realized that the fate of the matriarch was no longer important.

At last she achieved a consensus among the hunters.

The great diplo cow was now one hundred and twenty years old. Her hide bore the scars of failed predator attacks, and many of the bony spines on her back were snapped off. Still she was growing, now massing a remarkable twenty-three tonnes. But the degeneration of her bones, after their heroic lifetime of load-bearing, had slowed her cruelly.

On the day her strength finally ran out, it took only a few minutes of the herd's steady ground-covering trot for her to become separated from the pack.

The orniths were waiting. They had been waiting for days. They reacted immediately.

Three males moved in first—all of them sons of Listener. They stalked around the matriarch, cracking their whips, flimsy bits of treated leather that emulated the diplos' own supersonic crackle.

Some of the diplo herd looked back dimly. They made out the matriarch, and her tiny predators. Even now the million-year programming of the diplos' small brains could not accept that these skinny carnivores presented any threat. The diplos turned away, and continued their relentless feeding.

The matriarch could see the capering, diminutive figures before her. She rumbled her irritation, the great boulders grinding in her stomach. She strove to

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lift her head, to bring her own tail to bear, but too many joints had fused to painful immobility.

Now the second wave of hunters moved in. Armed with poison-tipped spears, and using the claws of their hands and feet, they attacked the matriarch as allosaurs once had, striking and retreating.

But the matriarch had not survived more than a century by chance. Summoning up the last of her energy, ignoring the hot aches that spread from the pinpricks in her side, she reared up on her hind feet. Like a falling building, she towered over the band of carnivores, and they fled before her. She crashed back to the earth with an impact like a sharp earthquake, her slamming forefeet sending waves of pain through every major joint in her body.

If she had fled then, if she had hurried after her herd, she might have survived, even throwing off the effects of the spears. But that last monumental effort had briefly exhausted her. And she was not given time to recover.

Again the hunters closed in, striking at her with their spears and claws and teeth.

And here came Listener.

Listener had stripped naked, discarding even the whip around her waist. Now she flew at the diplo's flank, which quivered mountainously. The hide itself was like thick leather, resistant even to her powerful claws, and it was criss-crossed by gullies, the scars of ancient wounds, within which parasitic growths blossomed, lurid red and green. The stink of rotten flesh was almost overwhelming. But she clung there by digging her claws into the flesh. She climbed until she had reached the spines that lined the matriarch's back. Here, Listener dug her hands into the diplo's flesh and began to rip away at the horny plates embedded beneath.

Perhaps in some dark corner of her antique mind the diplo remembered the day she had ruined this little ornith's life. Now, aware of new pains on her back, she tried to turn her neck, if not to swipe away the irritation, at least to see the perpetrator. But she could not turn.

Listener did not stop her frantic, gruesome excavation until she had dug down to the spinal cord itself, which she severed with a harsh bite.

For long days, the mountain of meat served to sustain the nation of hunters, even as the young played in the bloody, cavernous hall roofed by the matriarch's great ribs.

But Listener was criticized. *This is a mistake. She was the matriarch; we should have spared her until another emerged. See how the herd is becoming scattered, ill-disciplined, its numbers falling further. For now we eat. Soon we may starve. You were blinded by your rage. We were foolish to follow you.* And so on.

Listener kept her own counsel. For she knew the damage the loss of the matriarch had done to the herd, how badly it had been weakened, how much less were its chances of survival. And she knew it did not matter, not any more. For she had smelled the salt.

When the matriarch was consumed, the hunting nation moved on, following the savannah corridor to the east as they had always done, walking in the herd's unmistakable wake of trampled ground and crashed trees.

Until they ran out of continent.

Beyond a final belt of forest—beyond a shallow sandstone cliff—an ocean lay shining. The giant diplos milled, confused, in this unfamiliar place, with its peculiar electric stink of ozone and salt.

The herd had reached the eastern coast of what would become Spain. They were facing the mighty Tethys Sea, which had forced its way westwards between the separating continental blocs. Soon the Tethyan waters would break through all the way to the west coast, thereby creating a global current of warm, tropical waters that

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would cause a grand world-wide heating in the ages to come—but that breakthrough meant the sundering of a supercontinent.

Listener stood on the edge of the cliff, her forest-adapted eyes dazzled by its light, and smelled the ozone and salt she had detected so many days ago. The matriarch was dead, destroyed—but it did not matter. For, after walking across a supercontinent, the diplodocus herd had nowhere to go.

The orniths might have fared better had they had a more flexible culture. Perhaps if they had learned to farm the great sauropods—or even simply not to pressure them so hard in this time of change—they might have survived longer. But everything about them was shaped by their origins as carnivorous hunters. Even their rudimentary mythos was dominated by the hunt, by legends of an ornitholestes Valhalla. They were hunters who could make tools: that was all they would ever be, until there was nothing left to hunt.

The whole of the orniths' rise and fall was contained in a few thousand years, a thin slice of time compared to the eighty million years the dinosaur empire would yet persist. They made tools only of perishable materials—wood, vegetable fiber, leather. They never discovered metals, or learned how to shape stone. They didn't even build fires, which might have left hearths. The thin strata would not preserve their inflated skulls; their stay had been too brief.

When they were gone, the orniths would leave no trace for human archaeologists to ponder—none but the puzzle of the great sauropods' abrupt vanishing, an anomalous mass extinction in the middle of the dinosaur era.

With a sudden stab of loss, Listener hurled her spear into the ocean. It disappeared into the water's glimmering mass.

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Generation Gap

John G. Hemry

Illustration by Vincent Di Fate

Different phases of life require different approaches. The hard part is knowing when—and how—to change.

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"Is it real?" From the observation deck of the Generation Ship *Terra*, a compartment of cold, gray metal relieved only by wide display screens, the blue/white/brown world below seemed like one more video simulation played out within the confines of the ship's computer systems.

"It's real." Greg Tyre nodded toward the image. "I went to one of the airlocks, suited up, and went Outside for a look. It's there."

Frowns creased brows all around him as the crowd reacted. "Was your walk authorized?"

"Why does that. . . ?" Greg bit off his reply as he saw the frowns deepening. "Yes. I'm a ship maintenance and repair tech. I can authorize a walk whenever needed to examine the hull. I determined it was needed."

Most of the frowns disappeared at the reassurance and attention returned to the globe on the displays. Greg turned at a touch on his sleeve and saw Jane Fernandez had come up next to him. She leaned close to whisper. "Oh, dear. You might have broken a Rule, Mr. Tyre."

"Yeah," he murmured back. "Why get manic over that when we're looking at the planet our great-grandparents set out to reach?"

His answer came not from Jane but from a large man who shook his head, eyes narrow with disapproval. "Those Rules kept us alive and got us here, young man. Continue conforming to them."

Greg smiled back at the man. "Yissur." The man glowered at the youthful slurring of the respectful reply, made a clear show of reading Greg's nametag, then turned his back.

Greg felt a tug on his sleeve, following as Jane led the way out of the crowded compartment. As they closed the hatch behind them, Jane pointed back inside, made a gagging motion, then laughed. "I am going to be soooo glad to get off this thing. What do you suppose it'll be like?"

"A planet? Like the simulations, I guess."

"Oh, get real. It's got to be different. Come on, let's go to Port One and watch the screen there."

Port One, the first recreation lounge on the left side of the ship, displayed the same image on its display screen. A crowd of young men and women were scattered at the tables, eyeing the vision with rapt attention. "Hey, Jane. Greg," one hailed them. "It looks like Earth, doesn't it?"

Jane shook her head. "Different land masses."

"I don't mean in *details*."

"Then don't ask a planetary geologist for an opinion." Jane laughed again as she took a seat. "I still can't believe it. A real planet where I can actually practice geology."

Greg smiled and nodded. "Yeah. It's weird. We've been scheduled to arrive here about this time ever since our great-grandparents set off. But it never seemed real, not until we actually got here."

"It still doesn't—" Jane's reply was cut off by the image of the planet vanishing, replaced by the Seal of the Community of *Terra* Township and a loud fanfare of trumpets. "Oh, hell. What's Mayor Magetry got to say?"

The community seal slowly faded in time to the trumpets, replaced by the lined face of Mayor Magetry. Magetry looked slowly back and forth, as if scanning his audience, which he could indeed be doing if he chose to use the surveillance cameras in every compartment. "This is a good day." A low groan emitted from the young adult audience in Port One. Magetry had begun every speech of his career as mayor with that phrase, and since he'd been continuously reelected since his father stepped down, it had been a long career. "We have fulfilled the dreams of our ancestors by reaching this planet."

Jane cocked an eyebrow at Greg. "I

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thought our ancestors' dream was to establish a colony here."

"Me, too."

Magetry's face held a warning frown, now. "I must caution against irrational exuberance, against any weakening of the bonds and Rules and Traditions which have kept us happy and healthy over this long journey. The planet must be examined. Evaluated. A landing party will be sent out after due time. Until then, continue in your duties, praise our ancestors, and trust in the procedures which have brought us this far, and will take us further. If need be." Magetry's face spasmed in a brief smile, then faded out to another trumpeted chorus.

"Inspiring," Greg noted. "Why is that robotic assist the mayor, anyway?"

"Because he's always been mayor," Jane pointed out. "Just like his daddy."

"Yeah. Mayor-for-Life Magetry. Heaven forbid the voters should elect anyone else. They've always voted for a Magetry. Why change?"

Jane grinned and called out the question to the crowd. "Why change?"

The other young adults in the room smiled with the same mixture of mockery and bitterness as the crowd yelled back: "It's always been that way!"

Someone pounded on the controls to the display until the image of the new world reappeared. While a few, brief cheers rang out, Carl Chang came in, spotted Greg and Jane, and headed for their table. "Private party?"

"Nope. Have a seat. How's life in social paralysis?"

Carl managed to look pained. "Social programs, if you please."

"Same difference."

"Not to me." Carl looked around conspiratorially. "I caused a real ruckus in there, you know. I moved somebody's pencil box to the other side of their desk."

"Don't let Magetry find out," Jane advised. "Did you hear his little speech about irrational exuberance?"

"I couldn't miss it. What'd you expect Magetry to say?"

"I dunno. Some hint he's happy about reaching the planet we've been heading for all our lives, maybe?"

Carl shrugged. "Why should he be happy?"

Greg gave him a puzzled look. "I'd think that was obvious."

"That's 'cause you're young. At least in ship terms. You're, what, close to thirty years old? Change isn't totally scary to you. I'll bet it'll be a lot scarier when you actually encounter change."

"What's so bad about change? I'm sick of Rules, sick of Traditions, sick of having people watching me every second to make sure I'm not deviating from the social norm."

Jane nodded. "Ditto."

Carl spread his hands in a gesture of helplessness. "Look, you guys are always joking about my job in social programs. But all I'm doing is helping to carry out the original vision for this ship. As are the people who are watching you. You know what the *Terra* is, right? I mean, as a social unit?"

"Paralyzed." Greg pointed at the display. "Did you view the last update we got from Earth? I couldn't even understand some of the stuff they were doing and talking about, until I saw some five minute segment of people who acted and talked like us. And you know what? That segment was part of a popular *historical* drama that's all the rage back on Earth these days."

Carl nodded, obviously unsurprised. "Sure. Like you say, we're paralyzed. By design. What do you get when put a few thousand humans into a social unit and isolate them? You get a small town. The most socially conservative way of living known to mankind. Small towns don't change, because the social pressure is all aimed at conformity. That's us. Change comes to small towns as a result of outside influences. New people moving in, new ideas coming in. How much of that do we have?"

"None."

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"Right. We live like our great-grands did, because there's nothing forcing us to change." Carl leaned forward, speaking softly. "Even ideas. The updates from Earth get censored, you know."

"Everybody's heard that."

"Because it's true. Don't let any disturbing stuff enter the community. And guess what? Most of our little community is as happy as can be with that." Carl chuckled. "There's also the social system whereby people marry and have kids late. That's why people our age are regarded as 'young.' It all builds stability. People used to worry about breakdown in social order on generation ships like this one. But, really, they tend to the exact opposite. Social stability."

"And," Jane added, "if they start to veer from that, social programs gets them back on track."

"Um, yeah."

"Do you ever feel guilty?"

"A little. People can be happy without being happy in a socially conforming way. But not on a ship where carelessness or accident or riot could literally kill us all. Which is why we have Rules instead of just rules." Carl smiled briefly at the displayed image of the new world. "But, down there, we can relax, I guess. Maybe I won't feel any duty to keep people in line."

"What'll you do, instead?"

"Try to help people like Magetry cope, maybe."

"I'm sure he's planning on running that planet just like he's run the *Terra* all our lives." Greg smiled at the thought. "But down there we'll be able to leave if we want. Form our own town if we want."

Carl seemed disconcerted by the thought. "I . . . suppose. But it'll be just a few thousand humans against a whole world, you know. We'll need to stick together. Do what's best for everyone."

Jane eyed Carl appraisingly. "You sound like an elder. A conforming elder. As Greg and I were just saying, our ancestors' objective was to establish a human colony in another star system. It wasn't to keep things from ever changing in our society."

"I explained—"

"Something we already knew. We had to do it to stay alive and keep the ship from breaking apart. Fine. We made it."

Carl smiled once again. "Hey, no offense. I understand. Will you be going down with the survey missions?"

"I hope so." Jane's attention swung back to the image of the world below. "I can't wait."

"Why are *you* going instead of me?"

Greg smiled in what he hoped was a placating manner. "All I know is the shuttle pilot wants a maintenance tech along, and I got picked. Really, Jane. I had nothing to do with it."

"It's not fair!" She glowered at him, then spun on her heel to stomp away. "At least bring me back a rock!" Jane yelled over her shoulder.

"Sure. No problem," Greg assured her back just before she left the room. He took a deep breath, checked his tool kit, then headed for the shuttle docking bay.

"Tyre? I'm Trey. Shuttle pilot." A woman perhaps two decades older than Greg stuck out a hand and grinned. "I've gotten some of your stuff because of typos."

"Is that why you picked me?"

"Partly. I was familiar with the fact you existed. But I also wanted someone young enough to still be able to think independently."

"Excuse me?"

The pilot raised her eyebrows. "You don't understand?"

"Well, yeah. I just didn't expect that from, uh . . ."

"An old broad? I'm not that old, kid. And I'm a pilot, which means I value having someone with a good brain backing me up." She shook her head, gazing at the airlock leading to the shuttle bay. "You can train somebody to the point they stop thinking. Yeah, you do understand, don't you? All we've ever dealt

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with on the *Terra* are the same things, over and over again. I expect to deal with something new on that planet."

Greg smiled. "I sure hope so, ma'am."

"Give me a break. I'm not that old. It's Gayle." She checked her watch. "Come on. The schedule of events calls for our passengers to arrive in exactly twenty minutes, so I'm sure that's exactly when they'll all show up. Let's get some checks done."

The airlock felt no different from any of the airlocks Greg had used to access the outside of the *Terra*'s hull, but instead of open space it led into the bay of the shuttle. A dozen seats, six to a side, filled the upper part of the bay, while a hatch labeled "cargo" led to a lower area. Gayle Trey led the way forward through another hatch into the small cockpit, then indicated the seat next to her. "That's the flight mechanic's position. Strap in tight when the time comes."

"Yes, ma'am. Sorry."

"You'll get over it. So will I." She rubbed her cheeks with both palms, eyeing the navigational display. "We've been surveying the planet from orbit since we arrived, you know. We'll be landing on a plain not far from a major river. It's in what should be the planet's temperate zone, and looks well suited for a colony." Gayle grinned indulgently at Greg, who suddenly realized he had a huge smile on his face. "Really looking forward to it, huh?"

"You bet."

A chime announced the arrival of the passengers. "Wait here."

Greg pretended to study the instruments while Gayle led the survey team into the shuttle bay, then frowned as he heard a sharp voice. "Rules require the senior qualified mechanic in cases such as this."

"No, they don't," Gayle replied in a polite but unyielding tone. "The Rules state the senior qualified individual should be used *if* all other factors are equal. As pilot for this mission, I decide whether all other factors are indeed equal. It is my judgment that Mechanic Tyre is best qualified, and the Rules give my judgment priority."

Mumbles, grumbles and the rattle of seat harnesses being fastened were the only other sounds until Gayle returned and sealed the hatch. "You ready?" she asked Greg.

Greg belatedly realized he hadn't strapped himself in and fumbled with the straps, trying to sort out the tangle. "Blast it."

"It's not *that* complicated." Greg flushed as he saw Gayle watching him with an amused expression. "A bit nervous?"

"Hell, yes."

"Me, too. I've never actually flown this thing in atmosphere or a planetary gravity field. Just simulations. It ought to be interesting to see how accurate the simulations are, huh?"

Greg's eyes widened. "Uh, yeah."

She checked some readings on the panel before her, then smiled thinly. "Every month I've come in here and run system checks. Every month. Just like my dad did. Just like his mother did. Now I finally get to use it. I get to *do* something with it."

"It sounds like you're looking forward to it."

"Damn straight. Let's go."

Greg's stomach protested the shuttle's movement. A lifetime on the massive *Terra* hadn't prepared him for the lurches and swings of a much smaller craft. He gulped, praying he wouldn't lose his last meal, and glanced over at the pilot. Gayle sat, her eyes locked on the display, her hands gripping the controls ever so lightly.

The shuttle skipped across the upper atmosphere, shedding velocity and losing altitude, the outside image on the display growing wavery as turbulence and heat distorted the view. Gayle pushed the shuttle lower, easing up slightly as its structure vibrated under the strain. The sky grew bluer, the land

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more defined. Something white shot by in a flash, startling Greg, followed by another. "Clouds," Gayle breathed, like someone who'd just seen a miraculous vision.

Greg fought down a wave of panic as the planet's surface jumped toward them. Gayle touched the controls gently, correcting the shuttle's approach to the open field, as grass and other vegetation shot by close underneath. The forward braking thrusters fired, reducing the landing velocity, then the shuttle transitioned to hover before gently coming to rest.

Greg waited impatiently while the survey team painstakingly tested the planet's atmosphere. The atmosphere had already been sampled a dozen times by automated probes, but none of the team seemed willing to trust that data. Finally, the leader signaled approval and the shuttle's exterior hatch was cracked.

"What do you think?" Gayle had followed Greg out of the shuttle and stood beside him now, looking around.

"It's . . . overwhelming." New sights, new sounds, views running off to an horizon which seemed impossibly distant. "I've been in Earth-based sims, but this is . . . is . . . so much more."

"Yeah." She bent to feel the grasslike stalks beneath their feet, then jumped backwards as something small and grayish scuttled away from her hand. "A bug! Look! A bug!"

"Really?" It looked like the pictures he'd seen of bugs, anyway, though Greg had an impression of ten legs instead of six before the creature vanished into the surrounding field. "Does it bite?"

"It didn't bite me."

A shout echoed from where the survey team had huddled together. "Look out!" The team scattered in all directions, one member waving frantically toward Gayle and Greg. "Life-forms! Insectile life-forms! Look out! They're in the grass!"

"I guess they found a bug, too," Greg remarked. He eyed the ground uneasily, shifting his feet. "How many are there? Am I standing on one?"

Gayle took a step back onto the shuttle's ladder. "Maybe. Hey!" She swung one hand in a frantic motion as a small, gray object fluttered erratically near her head. "Another bug. A flying one. Bug repellent. We need bug repellent."

"That's right. We have the formula for that, don't we? If it works on bugs here." Greg brushed his hair back in annoyance as a breeze flipped it over his eyes. "Somebody's got the vent fans set too high."

"Vent fans?"

"Yeah, the— Oh. That's, uh, wind, right?"

"Right. It sets its own speed." Gayle squinted around. "Annoying, isn't it? I want to turn it down, too. Setting up house on a plain might not be a good idea if wind's a problem. What's that shining over there?"

Greg followed her gaze. "Water, I think. Isn't that where that river is?"

"Uh-huh. Good call."

Several survey team members came to cluster near the shuttle, one nervously staring toward the river as well. "That's dangerous, you know."

"Dangerous?" Greg questioned.

"Running water. Rapids. Undertows. Aquatic predators. Mud flats. Very dangerous."

"It looks sort of pretty from here."

"So does a neutron star from a distance. That doesn't mean you want to get near it."

"Floods," another stated.

"Right. Rivers can flood. Maybe we want to be someplace higher. The mountains? Aren't there fewer insects in the mountains?"

The first surveyor checked his data unit. "Yes. At least, that was the case on Earth. But it's colder in the mountains. And, uh, landslides."

"Landslides?"

"Falling rocks and soil. And snow slides. Same thing, in winter."

The surveyors headed slowly away

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from the shuttle again, scanning the grass as they carefully placed each foot.

Greg watched them, then jerked back as another bug zipped past his face. "Gayle? Do we have any of that bug repellent on the shuttle?"

"I sure hope so. Let's find out."

"I wonder why we didn't think to put it on before we left the shuttle?"

"Probably for the same reason we didn't think to wear hats." Gayle squinted into the sun. "That's a little too bright to be comfortable, too. Maybe we could get, uh . . ."

Another surveyor, gingerly walking past, looked over at her. "Sunburn. Yes. Painful."

"How do you know if you're getting sunburn?"

"Check your first aid manual for depictions of radiation burns. A sunburn is simply a relatively mild form of radiation burn. And that means it can lead to skin cancer. You should minimize exposure."

"Radiation burns? Just from walking around?" Greg shaded his eyes. "Is there anything down here that isn't dangerous or annoying?"

The surveyor paused, as if taking the question absolutely seriously. "We're still checking the planet out."

Some hours later, the surveying team gathered back at the shuttle. Some of them, those with the fairest skins, showed the blush of what the alarmed medical team member announced to be the first traces of sunburn. An additional hour was spent exhaustively searching for bugs which might be hiding in anyone's clothing or equipment. The flight back proved uneventful, more tiring than exciting after the labors of the past hours. Yet, as the survey team filed off the shuttle and back into the hull of the *Terra*, their spirits obviously rose. "We're back!" the team leader announced happily. "Everyone, get your reports filed as soon as possible."

Greg watched them leave. "Gayle?"

"Yeah, kid?"

"Back on the planet, those team members looked unhappy and uncomfortable the entire time. Now, they couldn't be happier."

"What'd you expect? They're home."

Greg looked around at the metal making up the surfaces all around. "Yeah, but . . . not anymore. We have to think of that planet as home."

"That's not going to be easy, Greg. Even for younger types."

"How long are they going to take to evaluate this planet?" Jane demanded. "It's been three weeks since you went down and nothing's happened. They haven't even staged one of their stupid contests, like 'let's name the planet.'"

Greg shook his head. "I don't know that any more than you do."

"At least I have my rock. Thanks for bringing that back, anyway." She slapped the table top. "They haven't even sent down any more survey teams! They're just analyzing and reanalyzing the stuff gathered by the first team."

"The automated probes on the surface are still sending back data—"

"If we wanted to examine this world by automated probes then humans didn't need to come out here in the first place!" Jane subsided, then glanced around Port One. "Where's your buddy Carl?"

"I thought he was your buddy, too."

"Well . . . where's he been?"

"I heard from him real briefly. Apparently you're not the only one chafing at the bit to get on the planet. Social programs is working overtime to keep everyone calm, productive and happy."

"Ugh. I'm sorry, Greg, I used to like Carl a lot, too, but the more I think about his job . . ."

"I know. But Carl's doing it for good reasons. He doesn't buy into it as an end-all like the elders in social programs."

"He didn't when he started out. That was years ago."

Greg frowned down at the table. "I don't think he's changed that much."

"You— Who's that?"

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Greg followed Jane's gaze to where a woman had entered the room, her maturity making her stand out next to the twenty-somethings who usually frequented the lounge. "Gayle Tyre. The shuttle pilot who took us down to the planet. She's good people, Jane."

"I remember you told me that. What's she doing here? Did she take a liking to you or something?"

"She's a little bit older than me, Jane."

"Some women like that. So do some men."

"Not this one. Besides, I prefer planetary geologists to pilots. I got you a rock, didn't I?"

"Be still, my heart."

The pilot scanned the tables until her eyes settled on Greg. Gayle beckoned Greg silently, eyed Jane for a moment appraisingly, then gestured her along as well. Greg and Jane exchanged glances, then rose to follow the pilot out of the lounge. They walked swiftly and silently through a procession of hatches and passageways until they reached a small compartment whose walls were lined with shelves holding pieces of equipment. When Gayle had sealed the hatch behind them, she waved around. "Junkyard. Stuff that can't be fixed and has been stripped of everything worth cannibalizing."

Greg stared around in amazement. "It can't be fixed?"

"This ship's a closed system. Eventually, even our stockpiles run low, even our repair and fabrication facilities run out of certain materials. And, no, the general populace isn't told. It might cause 'alarm.'"

"I don't understand. If it's a closed system, how can we run out? We recycle everything."

"Because it's a real-world closed system, kid, not a theoretically perfect closed system. Even if our recycling processes were 99.9 percent effective, we'd still lose something in every cycle. And part of our closed system deals with living creatures like you, me, and the veggie decks, none of which are incredibly efficient consumers of material. Some of the stuff in every cycle is just too hard to recover." She scuffed at the deck. "The vent filters can't pull in everything, either. Someday they may get desperate enough to run vacs over every square centimeter of surface inside the *Terra* in hopes of recovering enough lost dust containing critical elements. But even vacs let dust get away."

"Why'd you bring us here? Just to tell us that?"

"Because the surveillance gear in this room is also busted. It's been cannibalized to keep the cameras and mikes going in other rooms, where seditious youngsters like yourselves gather." The pilot slumped against the nearest wall. "The town council's made a decision."

"About what?"

"The future. Theirs and ours. The planet's been declared unsuitable for habitation."

"What?" Jane seemed to be in shock. "Why?"

"All kinds of reasons. Weather. Mercy, it can rain down there. Or get cold. Or hot. The wind blows. Right, Greg? Bugs. Animals. Plants growing all over the place. Tectonic activity. You might get earthquakes."

"That's just like Earth!"

"It's not being judged by people who've ever lived on Earth, young lady. It's being judged by people who've spent their entire lives, like their parents before them, inside a world where the temperature is always maintained at a comfortable level, there's no bugs in the beds, the plants are all kept in pots and the only storms are emotional."

"But . . . but . . ." Jane looked at Greg helplessly. "Any planet will be like that. Any livable planet. They can't evaluate a living world by the criteria of a climate-controlled ship!"

Gayle grimaced. "You saw them, Greg. On the surface. How'd most of the landing party react?"

"As if they'd been dropped into the

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first-stage recycling tanks. I sort of understood that. I mean, it was all so uncontrolled. So wild. But they were looking for a reason to reject the world, anyway, weren't they?"

"Yeah. You're pretty smart for a kid." Gayle grinned at the mocking reference to Greg's relative youth. "Those reasons are just an excuse. They don't want to change. Anything."

Jane stared at the pilot. "Like Carl told us. Stability is the primary virtue, the primary imperative, in the society of the *Terra*. Actually setting up a colony on that world would change everything, wouldn't it?"

"Oh, yeah. People who didn't like Mayor-for-Life Magetry could actually go somewhere else and set up their own town. The Rules wouldn't have to be Rules anymore." Gayle raised her hands as if grasping at invisible controls. "I could fly. Across a world. See new things. Let my kids fly, too, instead of endlessly training so their descendants could someday fly."

Greg remembered the air rushing past the shuttle's hull, the wild ride to the surface. "I can understand that."

"But it's more than that. Moving down onto that world means leaving this controlled little man-made world of ours. We'd have to deal with lots of stuff that we can't control. Like weather, just to give one example. That's a big change for us, too."

"Our ancestors did that. So can we. Why are you telling us this?"

"Because I don't want to put up with it and I don't know what to do! I've been living on this ship too long. My brain's almost hardwired. You guys can still think for yourselves, right?"

"How long have we got to think of something?"

"Twenty hours. That's how long it's supposed to take to get the course calculated and the main drives ready to propel the ship toward the secondary objective. Magetry and the others know some people will be unhappy with leaving here. They plan on announcing the decision just before they light off the drives so there's no time for anyone to do anything."

"The secondary objective." An alternate world in an alternate solar system. "It'll take the ship more generations to get there. We'd never see a planet again, would we?'

"No."

"And when the ship finally reaches that secondary world, whoever's in charge then, Magetry the Sixth or Seventh or Tenth or whatever, will decide that's unsuitable, too, won't they? And try to head for some tertiary world."

"I'd bet on that, yeah."

"Just try to keep things the same. Until the ship breaks too bad to fix and our descendents die in the middle of nowhere." Greg found himself laughing, then noticed the expressions on the faces of the others. "It's so damned ironic. Our ancestors set this up. They wanted an extremely stable social environment. Nobody rocking the boat, nobody trying to change things, and all so their descendents could someday reach another world and establish a colony. But they forgot that their stable social system might backfire at the critical point. Why should a system built on stability want to change things? Especially when the ship they built is so predictable and comfortable compared to the conditions we'll encounter on the planet? They worked so hard to make sure it'd succeed that they set this colonization attempt up to fail."

"We follow the Rules," Gayle pointed out. "Our ancestors could have set a Rule that we had to land on the planet. No options."

"But what if the planet really had been some hell-hole? Then Magetry and all his supporters might be shoving us into the landers regardless of what the surveys found." Greg looked toward Jane. "We've got to do something."

"Something? What kind of something?" Jane waved around to indicate

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the rest of the ship. "We can't take over. The security force won't back us, and a majority of the people on board will either support Magetry or refuse to oppose him. Even a lot of the younger adults. Most people don't want to rock the boat. We don't have to take a poll. You *know* that's true."

"Yeah. I do. I'd guess anywhere from one quarter to one third of the people on the *Terra* would feel like we do and be willing to do something to actually oppose leaving." Greg looked away, his gaze focusing on a forlorn piece of equipment, broken beyond repair, perhaps doomed to sit in this room as long as the *Terra* existed. Just like the human inhabitants of the ship. Something he'd said earlier tugged at his mind. The landers. "Then we have to leave."

"Leave? Just accept Magetry's decision and sit while the *Terra* heads for another star system?"

"No. I mean we have to leave. Leave the ship."

"What?" Jane took a moment to let the thought sink in. "How?"

"The landers. We all got taught about them in school. The flight and landing sequences are automated. Each one's got a bunch of supplies and equipment on board. And they'll each carry a hundred people down, right? We just take a few."

"A few? How many do you think will go with us?"

"I don't know. And we have less than twenty hours to somehow collect a group of people who feel like we do without letting anybody know we're breaking the Rules."

Gayle shook her head. "That's not your only challenge. You can't just waltz onto the colony landers. There's interlocks and alarms and system passwords. Those need to be bypassed or isolated. The landers can be warmed up in about an hour's time if they're like the shuttles, but you need to keep the ship's control room from knowing you're doing that."

"What about the people we're leaving?" Jane asked. "If we take the landers, what happens to them?"

Gayle shrugged. "They'll be fine. There's enough landers to take down almost the entire population, and each of them has an assortment of redundant colonizing gear on board. They're one-way transport, remember? Only the shuttles were designed for multiple ground-to-space flights."

"Are we also taking one of the shuttles?"

"Damn right we are. That's mine."

Jane checked her watch. "Twenty hours. There's no way you and I and the few other people we can trust can sound out literally hundreds of other people to see who wants to go."

"We don't have to ask everybody—"

"We have to ask a lot of them! I don't want to leave someone who really wants to go. And we'll need every person we can get. We'll need them for their skills, and their ability to do manual labor, and just for simple genetic diversity. Right?"

Greg bit his lip. "There's only one way to do this. We handle it like a propagating message. I sound out two people, who each sound out two people, and so on."

Gayle frowned. "That's very risky. If the wrong person hears, we can be stopped."

"What else can we do? Besides, one virtue of life on the *Terra* is we *know* our neighbors. Look, we'll use a password. Nobody gets the password until whoever sounds them out is sure they're with us. Up to that point, the discussion can just be written off as discontent and Magetry will think that'll be undercut when the *Terra* leaves, right? But anyone we're sure of will get the password and be told that when they get it they need to head for the landers."

"So what's the password?"

Greg hesitated, thinking of how they'd be violating the Rules which had governed their entire lives, and leaving the controlled comfort of the *Terra* for a future of uncertainty and toil on the

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planet beneath them. "'Forbidden fruit.' That'll be the password that we're leaving."

The elder standing watch at the hull systems panel glanced down at Greg. "You found that problem, yet?"

"Almost."

"I hadn't noticed anything wrong."

"It showed up during a remote diagnostic." Greg tried to keep his voice calm, almost bored. "Maybe it was just an intermittent thing, or a false reading, but the Rules say you have to follow up. Even if it is the middle of the night and I should be asleep with most everybody else."

"That's right. It's good to see you kids taking the Rules seriously."

Greg offered the watch stander a hopefully sincere-looking smile, then continued the careful job of bypassing the alert systems which would otherwise provide warning the landers were being accessed and powered up. A final connection, a final check, and he nodded with real satisfaction. "That's got it."

The elder was already losing interest. "Everything's okay, now?"

"Just how it needs to be." Greg left the area, trying to suppress a wild grin, then checked the time. Three hours. He'd already bypassed the secondary watch panel, as well as the panel in the main control room where an unacknowledged alert would eventually present itself. He headed for the lander access area.

"Jane? How's it going?"

His friend twitched wildly at the question, then glared at him. "Greg Tyre, do me the favor of not sneaking up on me!"

"Sorry. I've finished the alert bypasses."

"Great." She raised her data unit and punched in a command. "I've sent out the password. People should start showing up real soon. Gayle's already got people here ready to start warming the landers. Nobody asked what you were doing?"

"A couple of people. I gave them a remote problem detection story and they didn't question it."

Gayle Trey and a couple of others came to join them. "Why should they? Nobody makes waves on the *Terra*. Nobody breaks the Rules. Not if they know what's good for them and don't want to be shunned by their neighbors."

A short woman standing beside the pilot and dressed in the deep blue of the security forces smiled tightly. "And they'd usually get caught, because their neighbors would tell. Don't worry. I'm an old friend of Gayle's, and I'm on your side. I've seen how the *Terra*'s society works from the enforcement side. I don't like it. I want my kids to have freedom."

Jane nodded. "Did you rig the surveillance systems for this area?"

"Yes. They're showing an endless loop of the last hour's recorded activity instead of actually monitoring the area. And since that hour included absolutely no activity, everything will look fine to my soon-to-be former co-workers."

Greg exhaled heavily, staring at the security woman. "I never thought of that. I guess we're lucky you're coming along."

Another smile. "I suppose so. You'll need cops on the surface, too, I expect."

A large man pushed his way forward. "Hopefully not." He glared around. "In case anybody cares, I've severed the control lines running from all remote locations to this area. Even if they find out what we're doing, they won't be able to stop us at the last minute by powering down the landers or something." Another glare. "I'm tired of people telling me what to do." The man turned and made his way toward a lander entry bay.

Greg glanced at Jane and spoke softly so his voice wouldn't carry. "Did you see the look in that guy's eyes when he said he was tired of people telling him what to do?"

"Yeah. I guess freedom from conformity may have its downside in terms of some people."

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People began arriving in the lander area, in small groups for the most part, including families urged on by one or both parents. All moved furtively, constantly glancing around. Gayle greeted a few, exchanging thumbs-up gestures. "More pilots. Good people to have," she advised Greg.

"I bet. I noticed a family resemblance."

"I told you my kids would get to fly."

"Have you noticed the ages of these people?"

"You mean the mix of elders and youth? Sure. There's more younger ones, but not everybody gets beaten into conformity by age." She eyed the stream of arrivals, biting her lower lip. "There's a lot. Has anybody been keeping count?"

Jane rubbed her forehead and consulted her data unit. "I've counted five landers filled and ready to go."

"Huh. And there's at least a couple of hundred more lining up. Looks like we might get up to a quarter of *Terra*'s people. Cool."

Greg shook his head, staring at the people jostling into the access area. "Won't security see these people? I mean, they've got to be noticing all the traffic through the corridors."

"Depends if they're awake and watching or not. My friend the cop says they usually watch movies on this shift because nothing ever happens. And why should they expect anything different to happen tonight?"

"What if somebody told the wrong person?"

"If that'd happened, security'd already be here, right?"

"Or they'd be massing just out of sight."

The pilot shrugged. "If they charge, we slam the hatches and bolt. Too bad for those still outside, but I've no intention of letting the social programs people work me over."

"I can't blame you." Greg grimaced. "Social programs. There's somebody I forgot to tell."

Gayle checked her watch. "You've got maybe forty-five minutes before we're scheduled to go. But we might have to go earlier."

"I know. But I can't leave a friend."

Greg ran, along corridors which grew steadily more familiar, until he reached Carl's room. He hung on the buzzer until Carl, blinking sleep from his eyes, opened the door. "Carl. The town council decided to leave this planet and head for the secondary objective. We're bolting the *Terra*. Taking some landers. Come on."

Carl stared back at him. "You're not serious. Are you?"

"Yes! Come on. We're leaving soon."

"Wait a minute. Who's 'we'? How many people are you talking about?"

"I don't know exactly. Hundreds. Come on. This is our only chance for freedom, for change."

"Greg, if the council made the decision to leave, then they represent the entire populace. We have to respect that. We have to work together. No individual can put their wishes ahead of the group's, ahead of everyone else on the *Terra*."

Greg reached for Carl's arm. "Drop the social program cant, for heaven's sake. Let's go."

Carl's own hand came up and grabbed onto Greg's. "No. Let's go inside. Security has to know. It's for the best of everyone. Really."

"Let go of me!" Greg yanked back against Carl's grip, realizing as he did so that getting free would require a big fight, one certain to attract the attention of the security cameras monitoring this area. "Carl—"

"Greg, you can't do this."

A lifetime of resentment suddenly surged to the surface. "Don't tell me I can't make my own decisions, you son of a bitch!"

"I'm not—" Carl's eyes widened in surprise. Greg felt a smooth tube run next to his body, then Carl's body

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spasmed. Greg broke free, his own arm and hand tingling from the shock transmitted through Carl's grip, and turned to see Jane standing behind him with a security stun baton in one hand.

She stepped forward and jabbed the tip into Carl again, ensuring he was unconscious, then pushed his body inside and slid the door closed. "I told you so. Good thing Gayle told me you'd gone to get a friend, and I decided to come here in case this happened."

"Where'd you get that thing?"

"Gayle's security friend lent it to me. Come on. We've only got a few minutes left, even assuming this incident didn't attract anyone's attention."

They ran. An occasional person saw them, watching with curiosity as Greg and Jane hurtled by. As the entrance to the lander area came into view, they saw there were still a couple of dozen people funneling in. A moment later, pulsing red lights flared to life and speakers shouted out words which echoed through the quiet corridors. "Security alert. Security alert. Seal all hatches. All inhabitants of *Terra* remain in your current location. Warning. All landers are nonfunctional. I repeat, all landers are nonfunctional. Do not attempt to use them. Warning."

Gayle leaned out, her expression worried, then smiling as she spotted Greg and Jane. "What a relief. Get in here. Everybody!" she shouted, as some of the others hesitated in almost instinctive obedience to the orders the speakers had given. One man paused, then turned and ran back the way he'd come. The others crowded in, Greg last. Gayle physically pulled him inside, pushing the hatch shut even as she did so. "They're right behind you. Get this thing sealed."

Greg put his shoulder to the hatch, helping her slam it shut, then hastily punched the button sealing the hatch tight. "How do we keep them from opening it before we get to the shuttle? They've got to have an override."

"They do," Gayle confirmed. "Jane, you still got that stun baton? Thanks." She popped the access on the hatch controls, shoved the baton's tip inside among the circuitry, then flinched as sparks and smoke flew. "Hopefully that'll buy us a few minutes. Let's go."

Another dash, across the short distance remaining to the shuttle bay, while the last families who'd made it inside hurled themselves into the nearest landers. The large man who'd boasted of severing the control links was standing in one lander's hatch, laughing in booming tones. "They tried to shut everything down! They couldn't! I stopped them! I finally beat the bastards!"

"Great," Gayle yelled. "Get in that lander and go!" She paused at the entrance to the shuttle, punching an intercom. "All landers depart immediately. Hit the launch control. The landers will seal their hatches and stagger their launches automatically. The landing area's already programmed in." She glanced back. "There goes that hatch."

Greg followed her look, watching as white hot metal flared away on all sides of the hatch. Off to one side, he could see some of the lander hatches sliding shut with agonizing deliberation. Then the closing airlock shut off his view and he was scrambling for a seat along with Jane and a few other stragglers.

The last buckle had barely been snapped when Gayle's voice sounded through the shuttle's intercom. "They're at the airlock. Everybody better be ready, because we're out of here!" The shuttle lurched, falling free from the *Terra*. "Okay, I see four, no, five landers already out. There goes number six. I don't think they can stop any of them, now."

In her seat, Jane seemed to be simultaneously laughing and sobbing. "We made it. We're free. We're free."

Greg stared at the shuttle's walls around him. Free? Somehow, that felt more different than anything he'd en-

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countered on the planet they'd soon land on.

A long plume of light strung across the night sky, as if a comet were passing close to the planet. Greg stood silently watching that light, along with hundreds of others. The evening breeze felt milder than during his first visit to the planet, but also colder.

"They're leaving," Jane murmured. "They didn't even try to get us back. No promises. No threats. They're just leaving."

"They're probably glad to be rid of us. All the malcontents. Magetry's probably as happy as he's ever been."

"He can't be happy about losing the landers and all the supplies and equipment in them."

"It's not like he could've gotten them back. And all those supplies and equipment are to support a colony. Our colony."

"I guess." Jane lowered her gaze to the land around them. The wind made rushing noises as it passed around the bulk of the landers. Someone swore and slapped at an insect. "I hope those supplies include warmer clothes. It's a little cold."

"Yeah. Jackets and coats." He pulled her close. "I hope this helps for now."

"A little. What do we do now?"

"Figure out who's in charge. We'll need some sort of leadership. Decide how to govern ourselves. Decide if this is the best place for the colony or if we should shift the landers. Gayle says they can lift long enough to move maybe a hundred kilometers if need be, and we probably want to be closer to a forest so we don't have to haul lumber a long ways. Get the lander incubators going for the animal zygotes in deep freeze—"

"Thanks, but I meant you and me when I said 'we.' Do you want to get married?"

"Sure, as soon as—" Greg smiled. "I was going to say, as soon as we both hit thirty. But we don't have to wait anymore, do we? That Rule's gone."

"Like a lot of others, I'm sure. Did we do the right thing, Greg? There's maybe a thousand of us here. Maybe a few more, but that's a lot smaller colony than the ancestors planned on, and we're completely on our own. What'll tomorrow bring, and the day after?"

"I don't know." He stared at her, then started laughing. "For the first time since I was born on the *Terra*, I don't know what tomorrow will bring. I don't know what I'll see. Isn't it great?"

She laughed, too, and hugged him. "Yeah. But I know one thing tomorrow will bring for sure."

"What's that?"

"I'm going to find some more rocks. I've got a lot to learn about this world our kids are going to inherit." □

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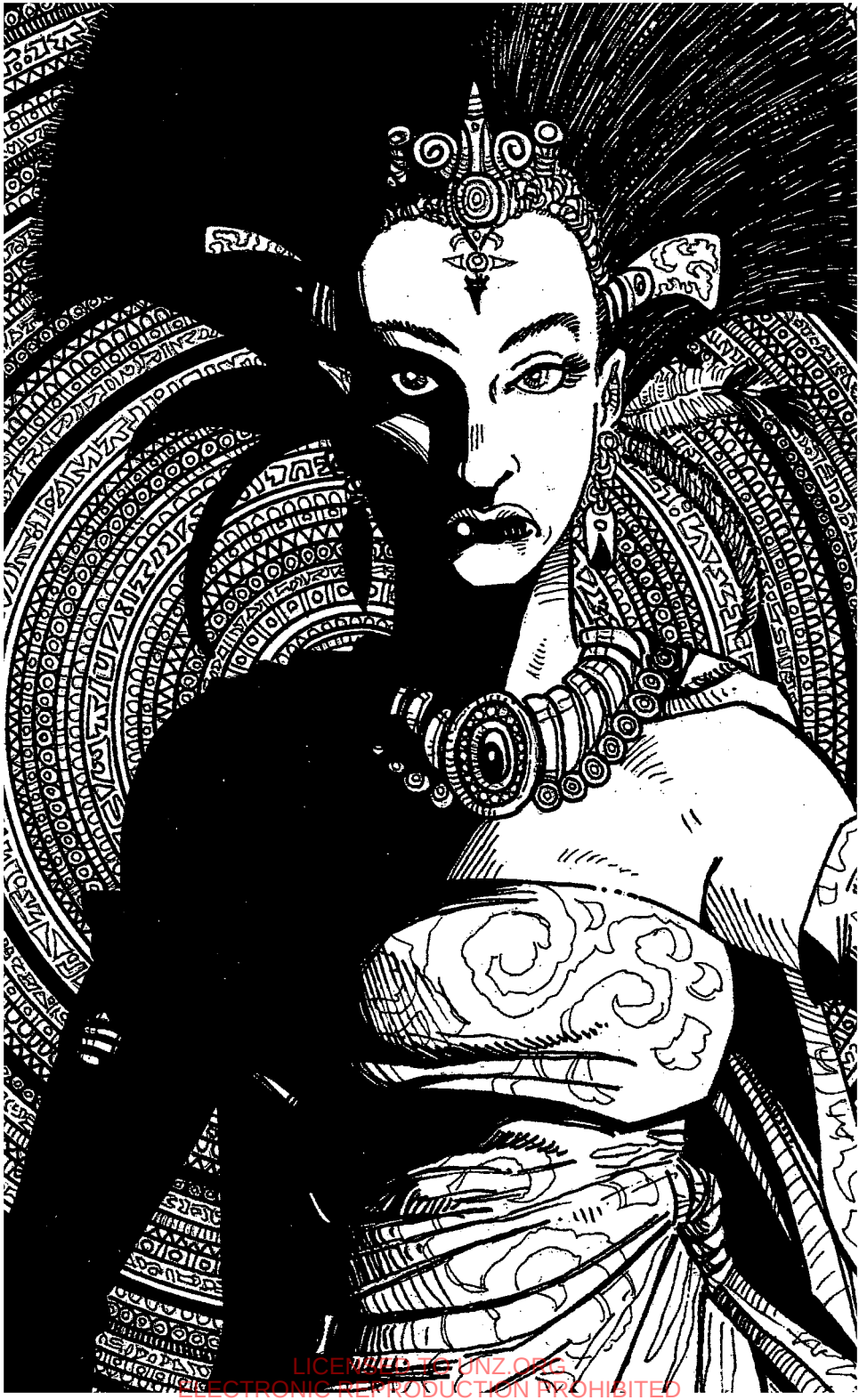

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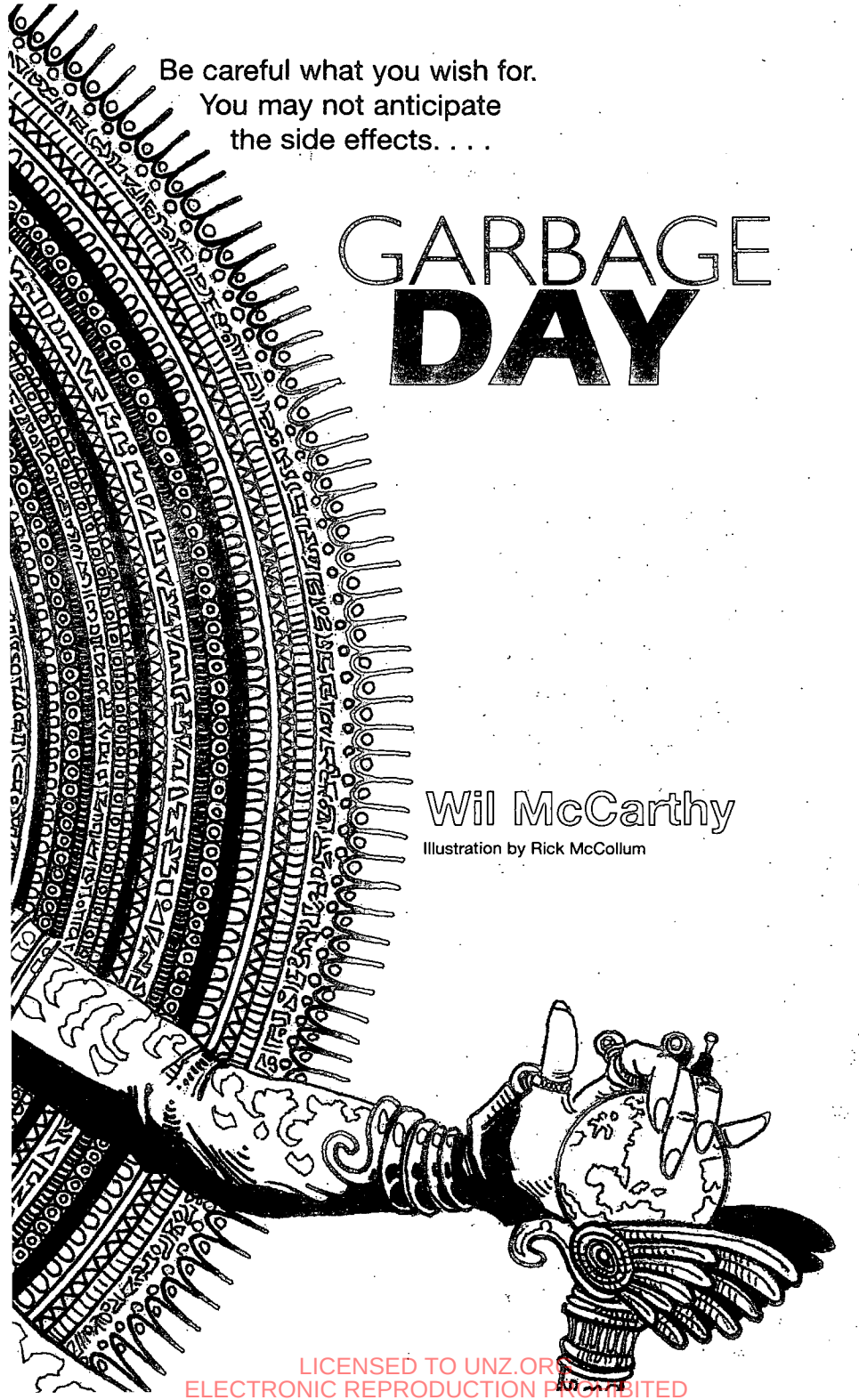
Be careful what you wish for.
You may not anticipate
the side effects. . . .

GARBAGE DAY

Wil McCarthy

Illustration by Rick McCollum



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1.
Camp Friendly

Conrad had never seen an angry mob before, much less been a part of one. Like an ocean wave it seemed to offer two alternatives: ride along or be smashed under. And the ride, truth be told, was fun; since the raid on the boathouse, and with it the capture of canoe paddles, the counselors were actually *afraid* of them.

Of a bunch of fourteen-year-olds! Even "Rock" Dengle was on the retreat, falling back along the side of the Arts and Crap cabin (and casting a worryingly broad shadow on its clay-and-log wall in the slanting light of a fake and miniature sun).

"What the hell you boys doing?" he demanded.

"Busting out," Bascal answered lightly. Cheers rewarded him at once, from Conrad himself as much as anyone. "Prince Bascal! All hail Prince Bascal, the Liberator!"

"This a summer camp," Rock pointed out. "Recreational. You here for fun, right?"

"Had enough," Bascal replied. Bascal Edward de Towaji Lutui, Crown Prince of the Queendom of Sol.

The badder boys—Steve Grush, and that Ho kid whose last name was spelled "Ng" but sounded more like "Eh"—were flanking Rock on the left, flicking cigarette butts and hooting, and you'd better believe *that* got his attention.

"I gotta hurt someone?" he wanted to know. He looked capable of it—strong and pissed off, but in control. Taking care of "troubled" boys was his job.

"We got to hurt *you?"* Ho Ng shot back, and gave him a whack on the skull with the paddle. Tried to, anyway; Rock deflected it with a sweep of his arm. But since that left Steve an opening to jab him in the nuts, it didn't do much good. Rock doubled over with a froggy kind of sound, but stayed on his feet. Taking on *fourteen* troubled boys was a bit beyond his faculties.

There was a definite satisfaction in seeing a big guy pacified like that, but then it looked like Ho or Steve might hit him again, maybe harder this time, and truthfully that made Conrad afraid, finally, of the consequences. And ashamed to be a member of this particular mob, yes, because Rock Dengle was definitely not a bad guy as jailers went. Kept the rules without treating you like a little kid, which was more than he could say for most of the others.

But fortunately, Prince Bascal stepped forward, into what would have been the line of fire. "Steady, men. Nobody wants to get hurt over this—we just need the fax gate."

"Can't leave without your parent or guardian," Rock said, attempting to straighten. "Regulations, no exception."

"Except today," Bascal said, and Conrad had to marvel at the casual, agreeable tone of this kid's voice, trained from birth in the art of persuasion. It wasn't going to *convince* Rock or anything—especially not after he'd been whacked in the balls with an oar—but it did put a vaguely legitimate face on these proceedings. Made it sound like their side of it had some validity.

Which it did; this wasn't a jail, strictly speaking, but neither were the boys free to leave, or to do as they pleased while "guests" of the camp. Which might be great if you were ten or something, but sucked hugely when you were old enough to want female companionship and other assorted contraband. But there was no one to complain to, no cops or social workers to call, no one here at all who was not in the immediate employ of Camp Friendly, and therefore an extension of the parents who'd banished them here.

So here in the twenty-ninth decade of the Queendom of Sol, on a miniature planet orbiting in the middle depths of the Kuiper belt, far from the Sun and planets, young men were forced—literally forced—to live out scenes from an

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earlier, less civilized time. So it made perfect sense for them to respond in an uncivilized way.

"You kids are in a lot of trouble," Rock cautioned. From his tone he was worried *for* them as much as because of them. He wasn't going to offer any further resistance—couldn't win if he tried.

On the horizon, twenty meters away, three more counselors materialized. One Conrad recognized but didn't know—he worked with the younger groups on the other side of the world. The other two were D'rector Jed, both copies holding the electric cattle prod he'd often warned about.

"What's going on here?" one of him demanded officiously. The other just stood there looking stern. It said a lot about D'rector Jed, Conrad thought, that he liked to go everywhere in twos. Did he enjoy his own company that much, or was he simply concerned that the Universe outnumbered him?

"Cessation of involuntary confinement," Bascal called back without missing a beat. "This man illegally tried to detain us."

The distance was not too great to see a veil of caution drop across D'rector Jed's features as he recognized Bascal's voice. He seemed to have trouble actually picking Bascal out of the crowd, though—before starting they'd smeared their faces with dirt and mussed up their hair, mainly as a way of psyching themselves up, but also, Conrad now saw, to blur the lines of identity which made them accountable.

"Your Highness," one of the Jeds said, and you could see him still mentally backpedaling, rethinking his approach. "Prince" was a funny word, a funny concept really; the child who would someday rule.

(If his parents weren't immortal.)

How did one treat a child, educate or punish or even reward a child, who would someday stand higher, enormously higher, than the educator himself? A tricky business indeed, and one which Bascal, in Conrad's limited experience, twisted constantly—perhaps reflexively—to his own advantage.

"Highness," the other Jed tried, "you and your friends have been entrusted to my keeping. I will not hesitate—"

"You *will* hesitate," Bascal shouted back, taking a large symbolic step in the Jeds' direction. "In fact, you'll stand aside entirely, or my merry men here will beat you both senseless. This is not a joke; they're escorting me for a call to Child Welfare Services, with whom I have a total legal right to consult."

This was news to Conrad; three minutes ago, the plan had been, "Come on! Let's show these bastards!" But this sounded better, more refined. Legitimate, almost.

"I've sounded the alarm," Jed told him. "It isn't just me you'll have to deal with, it's multiple copies of every counselor on the planette. Plus the Secret Service and Royal Constabulary."

"Yeah," Bascal agreed, "ten hours from now." That was the speed-of-light round-trip time from here to the Queendom proper.

"The fax gate itself is protected by your own Palace Guards. They won't let you leave."

"I don't need to," Bascal said. He glanced sidelong at Rock Dengle, who was still struggling valiantly to stand upright. "There's already been a regrettable incident here. We're prepared for there to be more if you interfere with us."

"Cancel the alarm," Rock advised, throwing his voice behind Bascal's. "Let 'em in the office. We don't outnumber them much, and they want to call Welfare, I say fine. Got nothing to hide. Parents need to know about this."

D'rector Jed didn't respond to that, but when the boys started moving, *en masse*, in the direction of the office, he didn't try to stop them, either. So they walked right past both of him and over the horizon, the little sun slipping behind the planette as they went. Small planets were like that—times of day

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were little places you could walk to. Here, the stars shone down like a vindication from God himself.

Superficially, the office looked like one more log cabin, especially in the dark. It was larger, though, and the light spilling out through the windows came from a proper wellstone ceiling, not a damn kerosene lamp. And once they got the door open and mobbed their way inside, the illusion was shattered completely. This could be anywhere in the Queendom—the bathroom had a *flush toilet*, for crying out loud. A further sign of the basic injustices here.

The fax was in a back room, a kind of entryway with no door. The camp had several other fax gates whose activation they could maybe have demanded, but this was the only one known to be on all the time, with a hardlink gated directly to the New Systemwide Collapsiter Grid, the Nescog, that could get their message—or even their material selves—out of here in substantially less than the blink of an eye.

Unfortunately, as promised, the gate was guarded by a pair of gleaming Palace Guard robots, their blank metal faces and sexless metal bodies both unreadable and immobile. They were here, no doubt, to keep unauthorized persons from entering Camp Friendly and harming, in some way, the Queendom's only prince.

Although, Conrad mused, the fax software could probably do that all by itself—filter out any images not specifically authorized here. Were these guards redundant, a hedge against someone corrupting the system somehow? Were they also parental spies, sent here to keep Bascal in line? Jed had certainly seemed to think so.

As bodyguards they were certainly intimidating enough; Conrad had little doubt they could burst from this room and be anywhere on the planette within minutes. The boys stood well back, milling around in the outer room, a few of the bravest eyeing these monsters from the "safe" distance of three or four meters.

Bascal alone seemed unimpressed, striding in toward the fax and gesturing at the two robots. "You, you, come with me. We're evacuating—the planette is on fire. *Come on.*"

He stepped right up to the fax and said, "Nearest emergency center." The robots hesitated for a barely perceptible moment, then the first of them, with alarming fluidity and grace, turned and leaped through the gate, vanishing in a puff of quantum dislocation.

The second robot seemed to be waiting for Bascal, seemed somehow to be expecting to follow him through. But instead it fell twitching to the floor, when Bascal produced a tiny, toyish-looking gun of blue plastic, and calmly made the robot's mirror-bright head disappear. There was no mess, and barely any sound. A teleport gun?

"Close the gate to incoming calls," Bascal said to the fax, then turned to his troops with a self-satisfied grin. "These parents of ours, they have nothing to pass on or share. Nothing to teach us except sit down, shut up, and live in their shadows forever. It's *their* Queendom, right? Always will be."

Grumbles of assent from the boys. They had immortal parents, too. They'd maybe given this issue some thought; Conrad certainly had. And anyway you just had to admire the prince's *cool*. Like it was all a game, like he could walk anywhere, through fire and bullets and untamed black holes, without so much as a flinch. You wanted to stand behind him, you really did.

"Well," Bascal continued, "What say we tear the place up a little? A night on Earth, my treat. You break it, *I* buy it."

Conrad had always had a problem with impulse—it was pretty much why he'd been exiled here in the first place. So while he knew there'd be hell to pay eventually, he really did like the idea of busting things up. What fourteen-year-old didn't?

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"Jesus Christ, Bascal," he said with conviction, "I'd follow you anywhere."

2.
Domes of the Popcorn Moon

They bounced through a repeater just inside the orbit of Pluto, and were funneled into a ring collapsiter segment where their signal could travel, for a while, much faster than the classical speed of light. Planets and planettes and planetoids whizzed by, unseen. There was no sensation associated with this; the boys' bodies and minds—perhaps their souls—were reduced to quantum wave packets for the journey. This was the NESCOG, the New Systemwide Collapsiter Grid, brainchild of Bascal's father. To an outside observer, the journey from Camp Friendly in the middle Kuiper belt, to Earth in the Inner System, could appear to take anywhere from eight to ten hours, depending on network congestion and the alignment of the various nodes and conduits. To the boys themselves, the journey felt—and for practical purposes *was*—instantaneous, no more significant or amazing than stepping through a curtain.

They could have specified a number of copies, and spilled out the other end *en masse*, an army of themselves. They could have specified a color, and come out painted bright blue. They could have specified an orientation, and come out facing backwards. But they did none of these things, and stepped out as themselves. Nothing else had occurred to them on the spur of the moment, and anyway antics like that would trip the filters and provoke inquiry.

On the curtain's other side was Athens, where it was noon, and brutally hot. Another single step whisked them around to Calcutta, which was also hot, and drenched in monsoon rains. They ended up in Denver, where the Sun had recently set on a summer-warm city, and the air was just fine. They spilled out into Market Street Station, jabbering, punching one another, giggling. Freedom was theirs at last, and the news of their escape could not have traveled any faster than the boys themselves. It would be a while before anyone came looking.

A billboard of animated wellstone proudly announced the station as one of only five public fax depots in the downtown area. A little map showed their locations, scattered across a kidney-shaped district a couple of kilometers across, and the flanking text informed the boys that ownership and operation of private fax gates within the exclusion zone was sharply restricted. Depending on the boys' exact destination, their transportation options from here included bus (free), automotive taxi ($), horse-drawn ("hansome") cab ($$), and of course walking, which according to the sign was strongly encouraged in a commercial preservation zone of Denver's caliber.

"Ooh," one of the boys said, pretending to be impressed, and of course emphasizing the remark with the raised, limp hands of some supposed effete aristocracy. It was Yinebeb Fecre who did this, with an additional layer of irony he probably wasn't aware of: by the standards of Camp Friendly, he *was* an effete aristocrat, the hyperactive child of two well-known television critics. Feck the fairy.

"Shut up," Bascal told him mildly. "Denver's raw. It's good."

Conrad hadn't seen the place except on TV, but overall he was inclined to agree. Back in his parents' day, fax technology had hit urban areas like a saturation bombing campaign, rewriting their maps and landscapes overnight. Many cities became beehives of addressable spaces whose physical locations were all but irrelevant. Streets vanished; sidewalks vanished; neighborhoods vanished. In some cases the cities themselves vanished, or became hypothetical entities with outposts scattered all over the solar system. But Denver's urban

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planners had seen it coming, had drawn this cordon around the heart of the city to preserve it from the tyrannies of convenience. Not just a Children's City, this, but a Federal Historic District and member of the Living Museum Network.

The terminal itself was underground, a dimly-lit urban space filled with columns and information kiosks and snack bars, and old-fashioned telephones that were probably just for show. Another billboard—this one illuminated with tiny red dots—announced periods of planned outage in the fax gates here, and periods of broadband connection to some specific destination for some specific window of time: HONOLULU 21:15-21:17 TODAY. There were ranks of embossed numbers along the ceiling, although what purpose they served was not apparent.

Some people carried luggage—an eccentricity in a world where fax machines could store any object in callable library routines and print copies on demand. There were other eccentricities apparent in the crowd: people who looked older or younger than the "ageless" standard of Queendom beauty. People who were dressed funny, people who had funny hair. And children of various ages, of course—comprising nearly ten percent of this crowd of dozens. The mix was interesting and cosmopolitan and yeah, highly raw. Fresh, original. Whatever. But everyone in the crowd—even the children—seemed to greet the arrival of fourteen unescorted, dirty-faced adolescents as a sign of trouble. A mother snatched up the hand of a toddler and pulled him close. Others were less overt, but their suspicion was lightly veiled at best.

Welcome to Denver. Keep your hands where we can see them.

Conrad gave back some dirty looks. It wasn't like people got away with crimes anymore; not when the whole Earth was one giant sensor. Even where events weren't explicitly recorded in a wellstone matrix they left, like, quantum traces in the rocks or something. Ghosts. With enough patience and computing power, almost any event could be reconstructed.

Ignoring the ill will around them, Bascal surveyed the chamber itself, and laughed. "I think we're here, men."

There was an escalator leading up to street level, and Ho Ng and Steve Grush, with hardly a glance at Bascal or any of the others, hopped onto it and went up. The prince, perhaps sensing a threat to his leadership, hopped onto the down escalator and called out, "Onward! Onward!"

It wasn't hard to run upward against the descending staircase, although what effort it took was strangely infuriating, the laws of gravity doubly stacked against you. And the people riding down were of course not amused as the boys swarmed past, but nobody said anything or tripped anyone, so Bascal made it to the top only a few moments behind Ho and Steve. And right there beside him was Conrad, the right-hand man, feeling important. Oh, he'd felt important a time or two already this summer, going to the same camp as the Prince of Sol. But this was different, this was nonaccidental. The two of them were *actual friends*.

"This is raw," he said to Bascal in a low, private tone, and the prince responded with a fist raised defiantly but low, where only Conrad could see it.

"Until somebody recognizes their *pilinisi*, me boyo. Then it gets complicated."

"Mmm." Conrad could only nod knowingly. "Pilinisi" was the Tongan word for prince, and he knew—or imagined he knew—what that meant for Bascal's life. No shortage of women, for one thing, but no privacy either. Everyone figured they knew him, when in fact almost nobody really did. But really, this disheveled boy in camp shirt and boating culottes didn't much resemble the Bascal Edward you saw on TV.

Up at ground level, circular doorways

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irised open for them in the terminal building's glass outer wall. The air outside was perfect: summer-warm and sunset-cool, not a bit muggy. It smelled of food: garlic and fresh-baked bread, maybe kettle corn popping somewhere nearby. The sidewalks were concrete with inlays of what looked like real stone—you could tell by the rough texture of it, not at all like a wellstone emulation.

So here they were: 16th and Market in the Mile High City, an almost mythical address. To the east a few blocks was Self Similar Street, where they were still recording the puppet show live every week. Somewhere to the south was the Cola Dome where the Broncos and Avalanche and Nuggets still played, where famous concerts were held, and paintball battles. On the streets, as advertised, was actual vehicular traffic: white buses and yellow/black taxis, delivery trucks and horse-drawn carriages. Rather a lot of bicycles, too, piloted not by children but by serious-looking adults swathed in impact-resistant wellcloth. There were also a few pedicabs drawn by midgets, which struck Conrad as an odd touch indeed: where did you find midgets in an age of perfect health?

The sidewalks were crowded and vibrant, full of obstacles for the pedestrians to flow around in artful patterns. This was a city of posts and pedestals, columns and obelisks. A fountain burbled merrily. There were little trees everywhere, maples and poplars and even acacias, no more than four or five meters tall. But the towers looming all around were anything but miniature, blocking the view. It was only when Bascal led them around a corner onto 16th Street that anything resembling mountains became visible, hulking dimly ahead in the sunset, shrouded by clouds, crowded from beneath by low buildings. But the mountains were lower than Conrad would've expected, or perhaps farther away. In the golden-red glow of the clouds it was hard to tell. But that was the direction Bascal led them: away from the towers, toward the sunset.

The boys made a rough passage through the city: hooting, snatching at leaves, kicking and leaping over benches, crowding people out of their way. There was no law against being surly, and oh boy did it feel good. Still, Conrad couldn't quite keep his eyes off the architecture. It was one of the few things he was good at and cared about: the history of building, and of the buildings themselves. Here, that history was written in the walls, layered like geological strata.

"Look at the sidewalk," he said to Bascal. And when that was ignored, he tried, "Look at that *wall*. Is it brick? It looks like brick."

"Whatever," Bascal replied, not mocking but barely looking, either. The question didn't interest him.

Conrad tried it on Yinebeb Fecre. "You study architecture, Feck?"

Feck raised his limp, sarcastic hands again. "Ooh, architecture!"

Okay, so maybe it wasn't a popular subject. Still, it seemed important—especially here. There were exactly two subjects Conrad hadn't failed in his last school year: Architecture and Matter Programming. These he pursued with an intensity that upset his teachers nearly as much as his apathy on the other subjects. Only History had inspired any enthusiasm at all, and only because this time it had included the Light Wars, which of course were the first intersection of architecture and matter programming.

The moment wellstone—programmable matter—had found its way into the old republics, the Light Wars had started. What anarchy: buildings greedily sucking in ambient energy, dumping waste heat, offending the eye with patterns of superreflector and superabsorber, with flashing lights, with blasts of communication laser unfettered by any cable or conduit. It was much

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cheaper to rustle energy out of the environment than to buy it off the grid, so all concern for aesthetics had flown right out the window, overnight, along with concern for the comfort of passersby and even, to some extent, for their safety. You could have all the electricity you wanted, if you blackly drank every photon that touched you. You could stay cool in the summertime, if your building was a perfect mirror focusing the heat back on unfortunate neighbors. In fact, if you were clever and obnoxious you could do both at the same time: deepening every shadow, amplifying every pool of brightness for your own convenience.

This wasn't as crippling a blow to city life as the Fax Wars twenty years later, but the scars remained even after the Queendom's founding, when the Architectural Courtesy edicts were rammed through. Here in Denver you could practically tell, just by looking, which decade each building had been constructed in: here an ancient steel-framed structure of poured concrete, its wellstone a mere facade. There a building of pure wellstone, held up against gravity by the pressure of electrons in quantum dots. (This had struck Conrad as a dumb idea the first moment he'd heard of it—what if there was a power failure?—but truthfully he'd never heard of a case where one of these selfish buildings had collapsed or dissolved. There must be all sorts of safeguards.) The majority of the buildings were post-Queendom: diamond frames and floors, with wellstone sheathing and facing. But even these had been dressed down, made to resemble materials of more or less natural origin.

Denver, like most of the really great cities, had forcibly regressed itself to something resembling the end of the twenty-first century. A preponderance of stone and metal and silica glass. Lighted signs had to look a certain way: like neon or mercury vapor or electroluminescent bulk diode. As the sunset deepened and the streetlights came on one by one, he noted with satisfaction that they were simulated gas flame. Had there been gaslights in the twenty-first century? If not, there ought to have been!

As the boys made their way westward, a full Moon slipped into view from behind one of the towers.

"Awooooo!" said a kid named Peter Kolb, pointing.

Bascal turned, looked, spread his arms. "Ah, now that is a Moon. July, to be specific. The Buck Moon. And we, my friends, are the young bucks making our way in the world. Let all the people of the domes of the Moon gaze down upon us in wonder. This is our night."

"Buck Moon? Says who?" someone asked.

"Says the Naval Almanac," Bascal answered.

Feck cleared his throat. "It's, uh, from the Algonquin."

Conrad turned. "Eh?"

"North American tribal society. Very old, but, you know, still in existence. Almost as big as the islands of Tonga, actually. Almost as many people."

Now everyone was looking at Feck, and even by gaslight you could see him blushing.

Bascal looked surprised. "Feck! You don't know things, do you? *Peter* knows things, he's the son of Laureates. Conrad *thinks* he knows things. But you? Ah, wait a minute, I'm perceiving something: you have a connection to this tribe. Wait, don't tell me! You're, let's see . . ." He studied Feck's complexion and features for a moment. "You're one-eighth by blood."

"One-quarter," Feck said, "But it's not Algonquin, it's Chippewa. Their neighbors. For us, this is the Raspberry Moon."

"Ah! You're practically a native guide! I had no idea."

"I've never been to North America," Feck said. "Anyway, this area is Kiowa, or maybe Lakota. The Horse Moon."

"We'll have to horse around," Bascal

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answered merrily. "And give a big, fat raspberry to the good citizens of Denver. Any other moons we should know about tonight?"

Feck scratched his ear, uncomfortable with the attention. The crowds were lighter here; the boys were practically alone in their pool of lamplight. "Uh, the Corn Moon? Or maybe it's Popcorn Moon. Also Raptor, Thunder, and Blood."

"Wow. That's raw. I like it. We'll screech like eagles, leaving a wake of thunder and blood. And raspberry popcorn! Actually, that's quite silly. But anyway the town is ours, and I say we take a bite."

Ah, the Poet Prince. Conrad snorted to himself.

Ho and Steve, unimpressed by this dialog, exchanged a look, then turned and started off toward the sunset again. And once again, Bascal seemed honor-bound to go after them, to assert himself. He got between them, and propped his elbows up on each of their shoulders, looking side-to-side and grinning.

"You know," he said, "a preservation district like this one runs on what they call a 'service economy.' You walk around looking at objects on display, and if you like one, the shopkeepers will print out a copy for you, or have it faxed to your address. Or you can sit in a restaurant, and order yummy comestibles from a highly restricted menu. Sometimes the whole selection fits on a card, or a sign. There's a theme to it. See, what you're paying for is ambience—the way things look and smell and fit together."

"Uh-huh," Ho said uncomfortably. He obviously realized that he was expected to reply, to suggest something. But he was just too damned stupid.

Steve Grush ducked away from Bascal's elbow, and then Ho did as well, and both the badboys were stepping back, sizing up the prince in some kind of unspoken power struggle. They never had a chance; at a loss for words and deeds alike, Ho finally shrugged, and gestured for Bascal to lead the way.

"You probably know where you're going. Sire."

Conrad couldn't help wondering if this was a learnable trick, something Bascal had had drilled into him by tutors. He hadn't really *done* anything—it might be something coded in his genome; some sort of dominant pheromone signature that made others feel more submissive the closer he got. Was such a thing possible? If so, it stood to reason that Their Majesties would give their son every advantage in the world. But perhaps being Prince was advantage enough; it wasn't like Ho could punch him out or anything, like anyone would stand for it if he did. Conrad felt a burst of pride and affection for this, his personal monarch, and it occurred to him that he would never *need* a trick like that, as long as he was standing right here at Bascal's elbow. That was all the leadership any of them were going to need. This was the whole point of a Queendom, right? The need to follow someone, to surrender—if only symbolically—that unpleasant sense of personal accountability. *Figureheads, right: they pretend to lead us and we pretend to follow. How very well we pretend.*

Bascal dogged their course left a block, to pass through rows of buildings faced with what looked, yeah, like actual brick (although this was hard to believe—couldn't it, like, fall off and hurt somebody?).

"Where *are* we going?" Conrad asked, in a tone that was private, but also calculated to be overheard by the other boys. Look, look, I'm speaking privately with your prince!

"Somewhere," Bascal said. He certainly seemed to know, or maybe he was just going by instinct, but his course seemed unerring and sure, and the boys followed along willingly enough. They passed a building labeled in big metal letters: UNITED STATES POSTAL SER-

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VICE TERMINAL ANNEX. How medieval. Did they still deliver "letters" and "packages" here, or was it just an old name, for an old building?

Westward they went: toward the mountains, away from the buildings, away from the towers and the lights and the crowds. The downhill slope in this direction was unmistakable. You could still see the afterglow of sunset up ahead, but otherwise it looked gloomy. Empty. Forsaken. Maybe they were nearing the edge of the fax perimeter—that would make these places harder to get to, right? Less valuable, less desirable. "Bad neighborhood" was essentially just a theoretical term to Conrad, but like the Light Wars, it suddenly made a new kind of sense to him here. Maybe there was less wellstone in an area like this, less record of what went on. Was that what Bascal wanted?

He felt obscurely glad, all of a sudden, that this raw, real place was one of the Children's Cities, where parents came when they felt the urge to spawn, and raise their young among others of their increasingly rare kind. Immortality was another wave that had hit society hard, and here was the reef where waves like that were broken. Denver! Denver!

The crowds were almost entirely gone now, the buildings thinning out into empty, meadowy lots hemmed in by gray metal fences. This afforded a very clear view of the mountains, and Conrad saw that one of the buildings he'd thought was downtown was in fact much farther away, in the foothills. The Green Mountain Spire, of course, a tapering, five-kilometer spike he should have recognized immediately, if for no other reason than because the top half of it was still in sunlight, and glowing as if hot.

Vehicular traffic tapered away and died. They passed along a pedestrian sidewalk and under a couple of bridges, until the area began to feel almost like a wilderness. There might actually be wild animals here. Heck, there probably were: rabbits and squirrels, and maybe even their predators. Would those be foxes? Mountain lions? As the walkway dipped beneath the bridges, cement walls rose up around it, mostly blank but with occasional attempts at ornamentation, inlaid tiles and bas relief sculptures of deer and mountain goats and bears, of trout in a little river, and a scene of the mountains themselves, which were visible again as the walkway emerged. Moonlight was now the primary source of illumination. Thank God for the superreflector glare of the Dome Towns up there, on the round-faced Popcorn Moon, or Conrad wasn't sure he could see at all.

The boys passed some benches where a pair of ragged men slept, and here was a genuine shock—there were hermits in the Queendom, he'd always known it, crazies and addicts and social malcontents. These ailments could of course be stripped away by the morbidity filters in any fax machine, but only with the patient's consent. Mind control was severely frowned on, so you inevitably got some sludge at the bottom of the societal keg. But this was a hypothetical issue, not something that should be sprawling on a bench right in front of Conrad Mursk, and stinking like rotten cheese.

Ho, racing out in front of Bascal once more, leaned over the benches and treated both men to a blood-curdling shriek. They startled awake immediately, their eyes wide. They didn't make a single noise of their own, and the look on their faces was one of frank fear, even when they realized the scream was just some kid having fun. They expected, what, to be beaten? Murdered? Dragged forcibly through a fax gate until their drunken heads were clear? Now *there* was a bit of teenage thuggery you could probably get away with. But Ho just laughed, and then Bascal was laughing too, and the boys were on their way again.

And then, without any warning at all,

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they crested a low hill or ridge and found themselves at the edge of the fax perimeter. You didn't need a map to see it, there was just this big park: grassy meadows and big stone staircases, and again with the little trees. Wellstone paths snaked through it, glowing faintly and tastefully in the moonlight, and just beyond these stood a row of brightly lit buildings, lining a depression that must be the Platte River.

Indeed, as they drew closer there was an unmistakable smell of "waterway" which Conrad had never realized he could recognize. Interesting. That smell had once meant the difference between life and death for his primitive ancestors, so maybe it was coded in his genes. Probably was, yeah. *Too much tinkering*, he thought, *and we could lose these little details. Stop being animals and start being something . . . else. Self-designed, with all the foolishness that that implies. Evolution is at least impartial.* But Conrad was young, and thoughts like that one were fleeting, like snow which melted rather than sticking.

Bascal clapped him on the shoulder, dragging him forward in the process. "Conrad, my man, you stop to brood every time we round a corner. You're thinking too much, and it's getting to be a problem."

"I've got impulsiveness issues," Conrad answered with a laugh. "You should be glad I'm thinking at all."

That seemed to make Bascal angry. "Your parents are what, a hundred years old? Two hundred? Fucking *experts* on the subject of impulsiveness."

"Actually, it was my school—"

"Well, to hell with your school. This is exactly why there are cities like Denver, where they at least make an effort. Parents ought to be forced to live here. It ought to be *mandatory*."

A thought occurred: "Maybe *you* should be in charge of the Children's Cities, guy."

But Bascal just grunted derisively. "Bring that bill before the Senate, hmm? I'll be fifty before they're finished debating. And still a child in their eyes."

"But your parents—"

This time, it was Bascal's fist on his shoulder, slugging. "Will you shut up? You are wrecking my mood. It's tiresome."

Ho Ng sidled up, showing fists of his own. "No pissing off the prince, bloodfuck. I'm going to pound somebody, and it might be you."

"Steady," Bascal said, holding up a hand. "We have common purpose here."

"What purpose?" Feck wanted to know. "We appear to be at the limits of the known Universe."

"Why, revolution," Bascal answered casually, pointing at one of the buildings. "Starting right there."

3.
The Wellwood Deception

Revolution. Wow. Fuck. Was that a metaphor? Because tempting as the idea might seem, fourteen fourteen-year-old refugees from summer camp couldn't do much against a whole Queendom, with its police and truant officers, its infinite supply of infinitely patient robots, and of course its billions of satisfied citizens in their tens of billions of instantiations. Even if the boys commandeered a fax machine and printed up an army of themselves, the Constabulary would simply shut down the entire area, round the boys up, and reconverge their many copies back into single individuals. The odds were so hopeless—and the threat of punishment so dire—that nobody had ever even tried it.

"I thought we were just looking for girls," Conrad said, to no one in particular. And that was who replied: no one.

As the buildings approached, it became clear that the river had a good bank and bad bank: one side facing the city and backing to the suburbs, while the other had a nice mountain view, but

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butted up against the bad neighborhood and so became bad by association. The most questionable of the buildings was an ancient two-story café whose shabby appearance was not an act, but the result of a natural wood facade that had stopped looking luxurious a few decades before Conrad was born. This, not surprisingly, was exactly where Bascal led them.

The café had a scattering of plastic tables and benches and chairs in front and behind, occupied by perhaps a dozen people of varying ages. None of them looked especially old, but then again who did? Conrad guessed a minimum age of around twelve—just old enough to be let out of the house—and a median in the low twenties, with the oldest men and women just edging into their Age of Artifice. Thirty or forty years old, when the fax filters stopped merely harassing the aging process, and began simply to arrest it. Lock it up, lose the key.

There wouldn't be many folks older than that, except maybe as part of the restaurant staff—this wasn't the kind of place you came to with your parents, it was the kind of place you came with your *friends,* to drink watered-down beer and coffee and feel independent. Not much draw for the older crowd. You could of course stay in the Children's Cities as long as you liked—some people stayed on as teachers or administrators or whatever, and a few remained as passive consumers, unable or unwilling to grow up, or else making up for an actual childhood spent someplace less raw. Calcutta, for example, was famous for its "Peter Pan Ghettos." But there were better places for people like that, where stronger intoxicants were available and everyone was above the age of consent. This place was what they called a "kiddie café"—no identification required for admittance. Whatever bona fide grownups you found here were probably up to no good. Which Conrad supposed was the whole point.

The name of the establishment appeared to be "1551," although maybe that was its street address, or possibly even the year it was built. Here, a flock of teenage boys was apparently considered less alarming than it was downtown. Only a few people looked up at their arrival, and any surprise they showed probably had more to do with dorky camp uniforms than anything else.

Bascal seemed to take this nonreaction personally; his easy stride broke into a trot, and he uttered a quiet, ululating sort of war cry and made an overhand "follow me" gesture to the boys behind him. They were officially taking this place by storm, and yeah, that did get a bit more of a reaction. A young man who'd been leaning against the doorway now shrank away from it, not caring to test his luck.

The place was a lot warmer inside than the cool breeze flowing down along the river. Poorly ventilated, Conrad thought, and with a wood face instead of a wellstone one, it couldn't pump the heat out electrically, either. Very rustic. Hell, it was almost like being back at the camp. The walls were an even mix of wood and plaster and brick, with wellstone surfaces only at the serving counters, of which there were several. A few animated posters hung on the walls, but there was also a lot of static graffiti done up in plain ink, and the reason for this was quickly apparent: each table had a big feather pen stuck prominently into a built-in inkwell. You could even see a few kids in the act of scribbling out their pent-up wisdom.

"They must wash these walls every week," he said to Feck.

Feck just nodded vaguely, his eyes on everything but Conrad.

A sign said "Please Seat Yourself," but there was also a staircase leading upward, and although the place was crowded with plastic tables and chairs and the people sitting at them, Bascal

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still had his momentum. A few zigs and zags through the crowd, a couple of bumped chairs, and he was on his way up, with Steve and Ho and Conrad right behind him, and all the other boys streaming after in a long line. People looked up at this, yeah. Looked annoyed, looked maybe a little worried.

The second floor was smaller, hotter, less crowded and less decorated. There was enough room for the boys to settle in at a corner clustered with round tables, but the doorway out to a balcony seemed much more inviting, and that was where they went. And if Bascal was looking for trouble, here was the perfect opportunity, because the balcony had seating for twenty or maybe twenty-five people, but was two-thirds full already, and the empty seats weren't in a block, but scattered all over the place.

Bascal Edward de Towaji Lutui was full of surprises, though; as the boys piled up behind him in the doorway, he could actually have cut a fairly menacing figure there. But instead he just stood up straight, clapped his hands twice for attention, and called out: "Excuse me! I'm afraid you're all going to have to move inside. The balcony is reserved for a private party."

The quality of his voice was something Conrad really was going to have to study: self-assured, vaguely apologetic, and entirely official. There was no question that you were going to comply, and if for some reason you didn't, well, there'd be all sorts of hassle for everyone involved, and in the end you'd still be vacating your chair, thank you very much. It took barely thirty seconds to clear the crowd, and settle in at all the good seats along the rail.

The last to leave was a girl of about sixteen, and Bascal, still stationed by the exit, grabbed her elbow as she passed. Wrapped in a loose-fitting dress of glossy black fabric. Her hair and eyelids and irises had been done up in a matching shade, while her lips and fingernails matched her shoes with a seething red-black glow, like bits of iron sitting at the bottom of a campfire.

"You lovely thing," Bascal said, "can you answer me a question?"

"Get lost," she replied calmly, jerking her arm away. Then she paused, taking a good look at his face. "Oh, whatever. What do you need?"

"Are you in a hurry?"

She chewed her glowing lip for a moment, then stopped. "I'm here with friends. We had a good table, which you just took, so yeah, I need to get inside and find something. Before they come back."

"Ah," Bascal said. "I won't keep you, then."

She half-turned to go inside, then checked it and faced him. "Are you . . ."

It hung unspoken: are you the prince? Bascal didn't answer. "Go on inside and get a seat for your friends. I'm sure that whatever . . . transaction is keeping them from you must be very important. But when you're settled, come and see me. Us. I have a question."

A brown-smocked waitress materialized, looking annoyed. "Did you just kick everyone off this balcony?" For some reason, she directed the question at Steve Grush.

"No," he replied, with his usual sullen brilliance.

"We'll have fourteen glasses of beer," Bascal said, jumping in. "And fourteen cups of coffee, plus some pitchers of ice water. To eat, we'll take some sort of chips and dip thing, and a big plate of cheese and veggies. Does it come with olives? I love olives."

The waitress had a wellstone sketchplate in her hand, but didn't write anything on it or speak to it. She was under thirty, but her look suggested she'd seen quite enough punk kids come swarming in here like they owned the place.

"Who's paying?" she wanted to know.

Bascal held up a thumb. "That would be me."

"Uh-huh." She presented him with the sketchplate, skeptically.

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"Authorized up to twenty thousand," Bascal said to it, rolling his thumb across its surface in the accepted manner, rather than simply jamming it the way punk kids were supposed to. "Plus a hundred-percent tip."

The slate chimed softly, acknowledging the transaction, and the young woman's features softened a little. Bascal's face and voice and thumbprint and DNA pattern all had to match against an account balance—he was good for the money. Still a punk kid, but apparently not a thief or mooch. That tip wasn't going to change her life or anything; all the necessities of life and most of its luxuries were free for the faxing, or at least had downloadable free knockoffs. And everything else had a free waiting list, so no matter how poor you were, you knew your turn would eventually come. Penthouse apartment, whatever, just live to be a million. But a tip was a nice gesture—traditional, polite—and a big tip was nicer still. He didn't have to do that.

"I'll see what we can do."

"Thanks so much," Bascal agreed.

The black-haired girl had slipped away during the exchange. Shrugging, Bascal sat down next to Conrad, who was worried and asked, "Can't they track you now? The police, your parents? Spending money is always the giveaway."

"Oh, probably. But the account has . . . certain security features that will slow down a search."

"Oh. That's good, I guess."

The last rays of sunset were visible over the mountains, between gaps in the apartment buildings on the river's far bank. From what Conrad could see, the buildings themselves were in tasteful colors, not selling anything or trying to be anything in particular. These were the homes of ordinary Queendom citizens, with fax gates inside, possibly right there in the apartments themselves. Here ended the Children's City, and there began the suburbs of the Queendom proper.

The Green Mountain Spire was dark most of the way up now, the sunlight glinting redly off the top hundred meters or so, and inching upward with near-visible speed. The café balcony itself hung over a precipitous three-meter drop, with a small grassy bank beneath, and then the stony shallows of the Platte River, which wasn't nearly as majestic as Conrad would have imagined: maybe twenty meters across, and quite shallow enough to wade in. To the north and south there were little sets of rapids, where men and women in glowing green kayaks paddled down and, incredibly, back up again.

Where the grass ended, the river's banks were lined with a random jumble of stones, and sticking up here and there were the concrete stubs of what probably used to be bridges. Conrad couldn't imagine why they'd never been removed, although they did lend an honest, unfinished sense to the area. Neither pristinely wild nor immaculately groomed, just here.

It only took a minute for the waitress to return, first with their drinks, and then again with platters of nacho chips, smothered in melted cheese and surrounded by battlements of carrot and celery, zucchini, and olive.

"Here you go, hon," she said, dropping off the final tray in front of Bascal and Steve and Ho and Conrad. "If you need anything, my name is Bernice. Just rap on the wall, or the railing."

"My grandmother's name was Bernice," Bascal mused, when she was gone.

"Nice lady?" Ho Ng asked.

Bascal shrugged. "Never met her. She died, like, two hundred years ago, in Catalonia. Mayor of a city. Fucking historical figure."

"Jesus H. Garbage," Ho cursed, in a show of solidarity. He was always saying things like that: "donkey fuckbrain vomit" and "diarrhea blood angel," and Conrad's personal favorite, "mother-Christing piece of dammit." Ho seemed to find

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some weird pleasure in mixing his cusswords up that way, or maybe it was some subtle organic defect in his neural wiring, that the fax filters dismissed as a mere character flaw.

In the Queendom of Sol, character flaws were considered your own damned responsibility—you had to identify them yourself and then formally authorize a medical doctor to repair them for you. Or better yet, you could treat it yourself through personal experience and growth. And either way, if there were side effects in your overall personality, well, those were your own problem as well.

But Ho was only fourteen, so really it was his parents who should be worrying about these things. And Conrad supposed they had, in their own special way: by sending the boy off to summer camp. Very therapeutic, oh yes. Nothing cut down on cusswords like having to shit in a goddamned outhouse.

A sour mood threatened briefly to come on, but the watery beer was really good somehow, and the nachos were even better, and anyway Bascal seemed determined that all his men should be cheerful tonight. Who could argue with that?

And then, before they'd even finished off their first glass, Bascal's black-haired girlfriend showed up again, pulling up a plastic chair and inserting herself between the prince and Conrad.

"Hi," she said, matter-of-factly. How much was unspoken in that one syllable! Hi, Prince. I know who you are, Prince; but I don't care—I'm here to check you out as one human being to another. Prince.

Which was fine, sure, except that it was Bascal she'd sat down with, not some ordinary puke two years younger than her. And she hadn't brought her friends, either. Probably hadn't even told them, for fear of having to share.

"Hi," Bascal said back, in imitation of her tone.

"Hello," Conrad added, with no particular inflection, figuring he might as well at least try.

The girl nodded, sparing him half a glance before focusing her attention on Bascal once again. She asked, with mock-indifference, "You wanted something?"

Bascal leaned back and smiled. "Seeing you, my dear, I can think of a lot of things to want. But I doubt we have much time, so I'll come right to the point: I need access to a taboo fax machine. I'm carrying contraband. What's your name, by the way?"

Her eyes widened. "I'm Xmary. You need acc—"

"Eksmerry? Is that a nickname? Short for what, Christina Marie?"

"Xiomara Li Weng," she answered distractedly. "You want *what,* now?"

"A fax machine. A simple, ordinary fax machine that will copy *ta'e fakalao.* Forbidden objects and substances. My men are here are on a mission, for which they have certain material requirements. Clothes, for one thing," he said, pinching his Camp Friendly shirt for emphasis.

"And what else?" the girl demanded, clearly concerned that this was a setup, that she was the focus of some sort of royal joke or sting operation.

"Jewelry," Bascal said, with an inscrutable little smile.

"That's all?" Her eyes flicked downward, then settled on the only jewelry Bascal was wearing: the well-gold signet ring on the middle finger of his left hand.

"Pretty, eh?"

"It's not an ordinary ring."

Now there was an edge to Bascal's voice. "Of course it's not an ordinary ring. I'm the prince of the fucking Solar System. What do I wear, gold? Tin? It's *information,* darling—quadrillions of terabytes in quantum storage. It wants out."

With a shiver of excitement and dread, Conrad realized that they weren't just playing at being bad here. They

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were *being* bad, they were going to be bad. Bascal was really pissed off about something. Hell, they all were. As fugitives from adult supervision, they had a goddamn point to make.

This girl Xmary, hearing the tone of Bascal's voice, sighed once and then said, "I know some people. I can ask for you. It sounds pretty serious, though."

"That it is."

Nobody said anything for a few seconds. Finally, the girl got up again. Before turning to go she asked, "Am I going to get in trouble?"

"Yes," Bascal replied. "We all are. The question is whether anything useful is accomplished beforehand."

"Great."

She disappeared. Doing as she was told, going along with Bascal and against her own better judgment.

"So what's in the ring?" Steve Grush asked.

"Garbage," Bascal said.

"Garbage?"

"Garbage. Reorganization of matter at the atomic level. Into garbage."

"You mean programmable matter, right?" Conrad asked, because otherwise that made no sense at all.

"Duh. Any wellstone surface. But that's everything, right?"

Well, sort of. There were still an awful lot of natural materials around, especially in Denver. But Conrad remained confused—wellstone was fundamentally a form of silicon. Woven nanofiber, right? Quantum dots to confine electrons in atom like structures. In raw form the stuff looked and felt like some heavy, impermeable, beetle-shiny plastic, but by sending the right signals through it you could fill it with artificial pseudoatoms of any type. Silicon and gold, silicon and sulfur, silicon and plaster of goddamn Paris. Then there were the transuranic pseudoatoms, and the asymmetric ones, and the ones which incorporated exotic particles. You could alter wellstone's apparent composition in so many ways that even after three hundred years, a Queendom full of pseudochemists and hypercomputer search algorithms had barely cataloged even the fundamentals.

But pseudoatoms weren't real, and silicon was.

Bascal was looking smug. "It's Garbage Day in Denver, me boyos. If we each have one of these, and we spread out, we can make a lot of frigging garbage. We can even threaten infrastructure, which after all is what separates us from the animals. If our demands aren't met, they will at least be remembered."

"Raw!" Steve said approvingly, and a number of the boys echoed him.

"Where did this software come from?" Conrad couldn't help asking.

"Wrote it myself, boyo. Been saving it for a special occasion."

Conrad proceeded warily, not wanting to sound negative. "How does it work?"

"I archived a year's worth of patterns from the palace waste chutes, and fit them together with a tesselation-tiler. Any surface is mapped with the best possible fit in stored garbage, and the boundaries between garbage objects are heated and acoustically shocked to cut them away from the parent body. Slap it on a wall, and you get a pile of steaming garbage."

"Except that it wouldn't steam," Conrad said. "It wouldn't stink. It might look like shit, or half-eaten food, or whatever. Probably even feel like it. But pseudoatoms don't have a smell. They can't leak out into the air, like real atoms and molecules do."

"Oh," Bascal said, suddenly uncertain. It wasn't a look that fit his face.

"Still, that's pretty amazing that you thought of that. You have got power for the separated objects, right? They're photovoltaic enough to maintain their own programming? And composition?"

"Um. I don't know."

"Oh," Conrad said. "Probably not, then. You'll just wind up with garbage-

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shaped chunks of nanofiber silicon. It's probably dangerous, too. I mean, there's more wellstone in a building than just the facade, right? You'd better be *real* careful what you touch with that thing, or you're going to hurt somebody."

"Who made you the voice of reason?" Ho Ng asked, acidly.

"Um, nobody."

"Why don't you shut up, then? Pussy."

Conrad had no response to that. He'd already said what needed saying. Getting any further on Ho's bad side was not a smart idea, and he could see that Bascal was brooding, too, looking around with dark, embarrassed anger. That anger could, Conrad knew, be directed at him at any moment. He considered apologizing, but didn't see how that would help. Better just to pretend he wasn't here.

"Are we still doing this?" Steve Grush wanted to know.

"Yeah," Bascal said, waving a hand distractedly. "Let me think about it for a minute." Then he pinched his chin in a gesture so reminiscent of his father that for a moment Bascal might have been a younger image of the king himself. A little swarthier, perhaps. A bit more angular. Conrad felt a fresh burst of affection for this boy, this young man, this Poet Prince of all humanity.

"I have to visit the *'soir*," Feck announced loudly, from the other end of the balcony. That was short for *pissoir*, and told everyone exactly, biologically, what he'd be doing when he got there. If he'd said *'toir*, or *shittoir*, that would convey a different intention. You always knew more about Feck than you wanted to. Still, it was funny—Feck *was* pretty funny sometimes—and suddenly there was a lot of laughter, and the conversation turned to other subjects.

"Sorry," Conrad said quietly, seeing his Bascal opening as Feck shuffled past. "It's still a pretty raw idea."

"Shut up," Bascal said vaguely, not looking at him.

Taking the hint, Conrad finished his beer, then just as quietly finished his coffee. Both were making him thirstier, but he resisted the urge to chase them with a glass of water. In a few minutes he was going to have to visit the *'soir* himself. He supposed they all were. He toyed with his coffee mug instead, clinking it a few times on the glass tabletop. Turning it over a few times in his hands. Good, old-fashioned stoneware, courtesy of the Friendly Products corporation, whose swirling green logo was glazed into the underside.

This didn't take any great scrutiny to discern; the same instantly recognizable design appeared on their Camp Friendly tee-shirts, and on thousands of child-oriented products produced daily by the fax machines of the world. Seeing it here was admittedly somewhat surprising. What was child-oriented about a coffee mug? He fantasized briefly, that this whole café—perhaps this whole ghetto—was just one more Friendly Park, in a carefully supervised Friendly Park world.

Oh, God, he was getting "maudlin," as his mother would say. It was exactly why she didn't allow him any alcohol, even weak and watered as this. If he drank any more, he'd become "rash," and *then* where would Queendom civilization be?

"Does anyone else want more beer?" he asked, looking around. But they were still ignoring him, which was probably good. He'd just order for himself, then, maybe even pay. Per the waitress' instructions, he leaned over and rapped on the deck's ratty old railing. It rang solidly under his knuckles, though, more like plastic or soft stone than wood. Because yeah, of course, it wasn't wood at all, just a clever wellstone facsimile. Why would knocking on a wooden rail summon a waitress?

Suddenly, his paranoid fantasy seemed less paranoid, less fantastic. If that rail wasn't full of microphones already, it easily could be on a moment's notice. If the constabulary had tracked the boys here, for example, or if the café

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staff had decided something suspicious was going on. Hell, the building could even make that judgment itself; most of the symptoms of human intelligence could be duplicated with a wellstone hypercomputer the size of a fingernail. Conrad's own house was always scolding him, checking up on him, ratting him out to his parents . . .

The black-haired, fiery-lipped Xmary reappeared, inserting herself deftly between Conrad and Bascal. "I found someone who can help you, Bas. Several someones."

Bascal looked up at her, and the confidence was back in his eyes. "Excellent. Thank you. And will these someones require payment?"

"I didn't ask, but I don't think so. They seemed pretty eager. I'm sure you realize, you're kind of a symbol around here."

"The Prince who Won't Be King? Lord of the oppressed? Spokeschild for the permanent children? I can't imagine." Bascal flourished comically with his arms, but couldn't quite keep the bitterness out of his voice. "Take me to your underground, then. We'll see what mischief this town can endure."

"Bascal," Conrad warned, raising his voice above the general hubbub, "We should get out of here. This place isn't as run-down as it looks. This isn't wood, it's wellstone. It could be a—"

The prince arched an eyebrow, and not in amusement. "There's business at hand, boyo. Connections to be made, a whole underground to be mobilized. One way or another, Garbage Day is a party I intend to throw."

Conrad became aware of some noise in the street, rising up like the soft clickety-click of a few dozen tap shoes. Like marching boots, approaching at a trot? Like the platinum feet of robots, dancing fluidly along the street?

"Bloodfuck!" Ho Ng called out, from his seat along the railing. "Constabulary coming. Lots of them."

"Ah," Bascal said, and his tone was of regret, not surprise. "All right, lads, hit the ground running. Scatter for me, and do as much damage as possible. Brew me up a genuine riot."

Conrad *was* surprised, and afraid, and maybe not entirely sorry they'd been caught. He looked Bascal in the eye, almost challengingly. "What are you going to do?"

"What do you *think?*" the prince snapped, then walked to the railing and punched it with his signet ring, producing a kind of porcelain *clink*. At the point of impact, there was a momentary sparkle of blue-white light, fading quickly to darkness. Nobody moved, nobody spoke. Conrad didn't so much as breathe. Half a second after impact, the change began: a sprouting and sprawling of shapes and colors. It shot along the balcony rail, down through its supports and onto the floor, onto the wall, up along the roof. The sound of it was like tearing paper, like crinkling foil. The building turned to garbage around them, and the narrow spaces between the garbage glowed, and sang, and cracked away.

Conrad watched Ho Ng drop right through the floor, just moments before the whole structure gave way, and suddenly they were *all* falling, in a storm of hand-sized wellstone fragments, like shiny black bugs. The sound of the building's collapse was remarkably low, more felt than heard. Weightless for so short a time that it barely registered, he thudded onto the steep riverbank, his fall partly broken by the plasticky fragments raining around him. His momentum carried him downward, skidding, briefly glimpsing the lights of an upside-down suburb reflected in the blurry water. And then a load of crap fell on top of him, stunning, immobilizing, whooshing the air out of his lungs.

He lay there for a few seconds, taking stock, trying to breathe, wondering if he were hurt or killed, if his parents would have to print a fresh copy of him from stored patterns. He'd died once before,

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in some sort of fence climbing accident when there were no other copies of him at large. Lost damn near the entire month, and never did find out what happened.

Finally, he had enough breath for a grunt of pain, and then a groan. Other groans rose up around him. And screams. And then suddenly the Constabulary was there, all around, men and women in bright blue, and faceless robots in naked, mirror-bright impervium. Hands were grabbing him, lifting, digging him out.

"Can you hear me?" a voice asked. "Are you hurt?"

Coughing, he struggled to stand. "I—ow! My tailbone. My back."

"Medic!" another voice called out. "Possible spinal! Recommend immediate faxation!" The hands on his body were gentle but very firm.

He looked around, trying to get his bearings. Trying, he realized, to recognize Bascal in the confusion of litter and bodies and flashing lights.

Then the first voice, someone behind Conrad, was speaking again. "Son, until we figure out exactly what happened here, I'm afraid you're under arrest."

"Yeah," Conrad said, slumping against the hands that gripped him. "I know it."

4.
The Battle in the Throne Room

Some sort of portable fax machine was set up right there at the crime scene, and the boys were processed through it. Conrad's injuries were healed almost as a by-product; the fax filters compared his body against his genome and the standard human template, concluded that the damage wasn't ornamental, and sent on a corrected pattern to the other end. That these operations were performed on a snarl of quantum entanglements, rather than on a person or even the image of a person, did not impress Conrad in the slightest. Indeed, he'd experienced the process many times before, and barely noticed it at all.

He ended up in a windowless interrogation room—or rather, an atomically perfect duplicate of him ended up there, while he himself had vanished. Died, if you like, although people rarely talked about it that way. He'd been through this experience almost daily throughout his life, and thought no more about it than about the dead skin cells he was supposedly shedding every moment of every day.

At any rate, here he was, in this windowless room with a human being and a robot. The robot didn't speak—they rarely did, except in emergencies—but it also didn't move, which gave it a vague air of menace. Especially since it was positioned between Conrad and the exit.

The human being, seated across from him on the other side of a table, was named Leslie Jones. She told him gently and repeatedly that she was there to help him. He was not restrained in any way, and the interrogation room's door betrayed a sliver of light at the edge. It wasn't even closed all the way. But he'd seen enough to know that Leslie Jones wasn't a lawyer or a social worker, and seemed in fact to be some species of cop, so he played as dumb as he figured he could get away with. Lying to the authorities would be worse than useless—they'd spot it before the words were even out of his mouth—but they were also unlikely to respect his intelligence, nor to be surprised if he didn't display much.

"Why did you leave the camp?" Leslie asked him, for the second time.

He shrugged. "We weren't prisoners."

"You could have requested a pass. And an escort. And permission from your parents. Instead, we have a counselor assaulted and a Palace Guard vandalized."

"I didn't do any of that."

"But you were there when it happened."

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Conrad didn't answer. They knew he was there. Between sensor records and skin cells and ghostly electromagnetic imprints, the Constabulary could probably trace just about every move he'd ever made.

Smiling, Leslie tried a different approach. "Conrad, you're not in trouble. Not very much trouble. No one was seriously hurt, and there's no evidence you did anything other than follow your friends, and then witness a crime. We just want to find out what happened."

He shrugged again. "You already know."

"Well, yes. But I'd like to hear it from you." She was wearing a green sweater with buttons made from what looked like live dandelion heads. Her hair was coppery red, and very short. He supposed she was beautiful—he'd never met anyone who wasn't—but she spoke and moved like the women of his mother's generation. Two hundred years out of date; born into a mortal world, and then "saved" from it by the rise of the Queendom. He wondered if faxes of this same woman were interrogating all the other boys as well.

"You don't know anything," he told her, not in a nasty way but just factually. "I'm sorry, but I really can't explain it to you. There's not even anything to explain." Then he disappointed himself by adding, "I want my mother."

Leslie just nodded, with a sympathy that seemed annoyingly genuine. "Both your parents have been briefed on the situation, and have asked to send copies of themselves here. The request is under review. However, as I'm sure you can understand, the involvement of Prince Bascal is a complicating factor."

Again, Conrad had nothing to say that would actually help the situation, so he said nothing, and Leslie simply started her questioning again, from the top. They went around and around like that for nearly an hour. Finally, when Conrad was halfway nuts with the repetition, a disc of yellow light appeared on the tabletop, and a little speaker formed beside it and emitted a soft chime.

"Well," Leslie said, eyeing it, "we tried, anyway. You seem like a nice young man; you should try opening up a little."

"Oh yeah? Why?" Conrad couldn't help asking.

To her credit, she thought about that for a couple of seconds before replying, "Because childhood doesn't excuse rudeness, not in a child your age. Whatever problems you believe you're facing, communication is really the only way to tackle them. You'll understand this someday, when you and your friends are the ones in charge."

Conrad didn't even try to suppress his sneer. "What day is that, Leslie?"

She really looked at him then, rolling her tongue around behind a set of pursed lips. Finally, she said, "Look, we've all made adjustments. Nobody said life was perfect. But we do have forever, yes?" She rose to her feet then, and motioned for him to do the same. "Come on. As I feared, the case has been placed under palace jurisdiction. Back to the fax with you, I'm afraid."

For some reason, Conrad felt a shiver of fear. "Why? Where am I going?"

"To the palace. Didn't I just say that? Best behavior, Conrad; you're going to meet the king and queen."

The throne room of Their Majesties, Bruno de Towwaji and Tamra-Tamatra Lutui, looked exactly like it did on TV. Same reed mats over wellstone floors, same Spanish tapestries over wellstone walls, same guilded wellstone scrollwork along the ceiling and floorboards and high, vaulted doorways. It was daytime here; the ceiling was clear at the moment, and light streamed down through it from a blue-white sky, much paler than the sky of Camp Friendly.

A pair of vaguely familiar women were here, with the black hair and walnut skin of South Pacific ancestry, and the elaborate wraps and hair fans of Her

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Majesty's court. With prim nods and subtle gestures, the two of them gathered the boys out of a pair of fax machines, and lined them up two rows deep in front of the empty thrones.

Lucky for Conrad, he got to stand two spaces from Bascal, near the middle of the front row, not four meters from the raised dais on which the thrones themselves rested. Lucky, lucky. His heart was hammering wetly in his throat; he'd never been so nervous in his life, even the first time he'd spoken face-to-face with the Poet Prince. He still wanted very badly to see his parents; he had no idea what was going to happen to him, and the prospect of an angry king and queen was far more frightening than the bland, dutiful sympathy of the Constabulary.

The Queendom's royalty were technically figureheads, without any official political or legal powers. But they were also beloved, and brilliant, and so absurdly wealthy that they could buy the planets outright, if they chose to. So in the end it hardly mattered: in the spiritual hunger of the Restoration and the perils and tragedies of the Fall, these two had been chosen as humanity's penultimate leaders. Whether or not Conrad liked or understood it, they could dictate his fate and no one—not even his own mother and father—would challenge it.

Still, this mortal fear didn't keep him from noticing that the "boy" to his left in the row behind him was actually Xiomara Li-Weng, from the café, and that the fourteen assembled children did not include Feck. In a way, this made sense: Feck had been in the 'soir when the building came down, and if he'd had the sense to get rid of his Camp Friendly shirt then at first glance there'd be no reason for the Constabulary to connect him with the events on the balcony, or to distinguish him from the café's regular customers. Whereas a quantum reconstruction of the collapse would show Xmary standing right next to Bascal, on the balcony with the other Friendly campers.

But despite her short, dark hair and rail-thin figure, Xmary did not resemble Feck in the slightest. Conrad didn't even see how she could be mistaken for a boy, although she'd rubbed the lipstick off and lost the low-toe shoes, and even somehow taken off the nail polish. She wasn't wearing a Camp Friendly shirt, but then again neither was Ho Ng, who'd somehow traded his for a shiny gray pullover and quilted vest, although he still had the pants: beige culottes that completely destroyed his efforts to look raw.

Even so, the error was alarmingly stupid. Had no one checked the biometrics or the DNA, or even peeked under the jacket? Had the ire of king and queen so disrupted police routines that even the Constabulary could somehow arrest the wrong person? Hand her over in a moment of confusion? It was a chilling thought, and a reminder of why the Old Moderns had murdered off their royal families in the first place, leaving only the Princess of Tonga and the swashbuckling Declarant-Philander of Spanish Girona to lead them into the future.

One of the Tongan ladies, gliding back and forth along the front row like a dolled-up drill sergeant, paused suddenly in front of Bascal. Placed a finger under his chin and lifted slightly, commanding his attention. Conrad couldn't make out what she murmured to him, but he did hear the prince's incongruous reply: "Lemonade. Please."

Then a chill settled over the room. To the right of the dais, a figure had appeared in the doorway. She had the same walnut skin and raven hair as her courtiers, but her wrap and drapes and hair fans were of purple, streaked and patterned with Polynesian tapa-styled highlights of glowing white. She was flanked on either side by ornate Palace Guards of gold and platinum, and news cameras buzzed and flickered in the air behind her, like fireflies. She wore a dia-

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mond crown, and was using the Scepter of Earth as a walking stick, and somehow she brought the whole thing off as casually as any jogging suit or camp uniform. No friend or relative ever had a face so familiar, so instantly readable. The queen was furious.

She was also controlling it tightly, which made it even scarier somehow, and it was all Conrad could do to keep from flinching or even cowering as her gaze swept across him. In theory, she could order his head chopped off and his backups erased, and it would probably happen.

But Tamra-Tamatra Lutui, the Queen of Sol, had eyes only for Bascal as she ascended the dais and settled comfortably into her gilded wicker throne. Her robot guards, armed with tall, flimsy-looking axes, assumed positions on either side of the dais. The news cameras drifted out into the room, documenting the scene from all the most dramatic angles. Conrad wondered if he was on television, or would be later on in some carefully edited scene. Maybe these were simply the palace's own archival cameras, storing holie video into a library somewhere.

"All right," the queen said. "Let's hear it." There was no question whom she was addressing.

"*Malo e lelei*, Mother," Bascal replied amiably. "I've missed you."

"*Tali fiefia*. And I you," she said, with apparent sincerity. "But you're back a little early. And in trouble again. And this time, you've brought friends."

"Yes, mother."

She raised her eyebrows, tapped a foot. Finally, she spoke in tight, parental tones: "Bascal, don't try my patience, not today. You know I love you, but what you don't seem to understand is that I *will* make an example of you."

"On the contrary," the prince said. "I'm counting on it." His voice was still friendly, but his at-attention pose struck Conrad as both a rebuke and a mockery of his mother's authority.

Tamra shook her head a little, and sighed. "You think you're so clever, Bas. This isn't a chess game, where it helps to look three or four moves ahead. It's more like the tide, which comes in when the Moon drags it in, regardless of what anyone thinks or says."

"Then I'll plant a neuble on the beach," Bascal answered smoothly.

This was metaphor, Conrad realized. A neuble was a billion tons of liquid neutronium in a two-centimeter diamond shell, and would drop through beach sand or even solid rock like a cannonball through wet tissue paper. But it would affect the tide, you bet.

"Enough," Tamra said coldly. "This isn't a debate. You've injured nearly a hundred people, and destroyed a building. Someone could easily have been killed, in which case you'd be going to prison."

"I *have* been in prison," Bascal answered, finally betraying his anger.

"No," she said, "You haven't. You've been at summer camp."

"It's winter here, Mother."

"And summer in Catalonia, yes. When I was a girl, most of the world lived in conditions much worse than your Camp Friendly, and never thought twice. If you can't see the difference, then perhaps you should spend some community service time in the actual punitary system."

"Fine," Bascal snapped. "None of my tutors have been criminals yet. It's a real gap in my education."

The queen slammed the metal butt of her scepter down on the tiles of the dais, with a sound like a heavy door slamming shut. "Darn you, young man. Must you battle us on every front? At every step? Do you despise us because we're your parents? Because we're the First Family? Because we're older? You've made your little statement, all right, but you know very well it turns people away from your cause, not toward it. I miss your poetry, I really do. But I suspect that's the very reason you stopped writing it."

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Bascal's stance never changed. "The summers here used to inspire me. I truly loved them. But then you sent me alone to Girona. Tending *sheep*. And then it was coconuts on Niuafo'o, and finally peaches and onions in the outer solar system. And you wonder why I'm angry?"

"You were angry before you left," the Queen said. "So eager for independence, and yet so unwilling to accept it."

"Independence?" Bascal said darkly. "At Camp Friendly? Surely you're joking. Rebellion turns *adults* away from my cause, Mother. The children understand."

With a rustle of fabrics, the queen stood up, raising a hand that might have pointed, or gestured angrily, or balled into a fist. But instead, she dropped it and turned away. "I see the day is gone when you and I can speak. Have it your way, then."

She stepped off the dais, on the opposite side from where she'd gotten on, and strode briskly to the other arched doorway, disappearing around a corner of wellstone-emulated plaster. Conrad heard a knock, and the mock creak of a mock door opening. Then hushed voices that reminded him of his own parents, when they closed themselves in their bedroom for an argument. It was oddly reassuring, to see the Queen of All Things acting just exactly like somebody's mom.

Conrad spared a glance at Bascal, who was looking evilly smug, having gotten the better of the worlds' most important person. He also peeked back at Xmary, who was standing there with her arms behind her back, trying to be as invisible as her clothes and her girl-ness would allow.

The guard robots had disappeared with the queen, and one of the Tongan courtiers had vanished at some point as well, leaving only the other one to watch over the boys. She was looking after the queen, and presently stepped into the hallway behind her, stopping at the corner.

Conrad, deciding to risk it, turned and spoke to Xmary in quick whispers. "What are you doing here?"

"Be quiet," she whispered back, not looking at him.

"But why—"

"Be *quiet*," she said, then met his eyes for a moment and added, even more softly, "Young people are supposed to shake things up. I'm here because someone else isn't. Now be quiet about it."

Was that what she thought? Did she have visions of Feck the Fairy, brave confidant of the prince, scrabbling around the underside of Denver, quietly fomenting revolution? Conrad nearly laughed out loud at the idea, and even more nearly giggled. He settled for a smirk she would probably misinterpret. He tried to get it off his face, but the effort only made their situation seem that much funnier. Most likely, even if Feck didn't get caught he would turn himself in to his parents before the Sun had even risen.

Conrad was going to say something about it to Peter Kolb, standing between himself and the prince. Crack a joke, something, but the Tongan lady had turned back toward them again, and was making little "come here" motions with her hands. "Boys, come. The king will see you in his study."

The two neat lines broke up into a kind of V formation as Bascal strode toward her, with Conrad and the rest of the boys trailing uncertainly behind. Meeting the king was less scary somehow, and the prospect of actually standing in his study was strange indeed, because Bruno de Towaji—once a Declarant-Philander, a genius and consort and knight of the realm—was the inventor of everything from collapsium to the blitterstaff, from the fax transport grid to the pub game of Shuffle Acrostics. He'd also saved the Sun from collapse or something during the Fall, hun-

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dreds of years before Conrad was born.

Bascal led them into the hallway, pausing for half a step to thank the courtier, whom he called "Tusité." The office door was just a slab of wellstone, folded out from the faux-solid material of the wall, but it was made to look like an ancient thing of wood and iron, more romantic than spooky.

The room itself was unadorned, and cluttered with mysterious objects and diagrams. The king was an inventor still, deeply and constantly concerned with the Queendom's technological underpinnings. Unfortunately, his study was rather small inside, and as the boys (and girl) shuffled in behind him, Conrad found himself squeezed up against Bascal, and against the room's only chair, which held a hairy, rotund, vaguely unkempt figure which took a second or two to register as His Majesty, unprepared for audience.

The king held a stylus in each hand, and seemed absorbed in the moving images his desk was projecting. With visible effort, he looked up into Conrad's face.

"Er, hello," he said, scratching at his beard with one of the styluses, then dropping it on the desktop and holding out a hand. "I'm Bruno."

Feeling distinctly weird about it, Conrad took the hand and shook it. "Conrad Mursk, sir."

The king nodded and withdrew his hand. "Ah. Well. It's 'sire,' actually. One must observe the proper forms. It's the only real purpose the office of 'king' serves, and it *is* a real purpose. Kindly keep it in mind."

"Um, sorry. Sire." Conrad blanched inwardly, and probably outwardly. He wished there were some way for him to step back, without toppling his fellow campers like shuffleboard pins. He also wished he could shut up, but that impulse control thing was going strong, and words were rising out of him like gas bubbles. "What is that you're working on? A planette?"

The diagrams before the king showed various cross-sections of some layered, spherical object, many hundreds of kilometers across.

Bruno's gaze flicked from Conrad to the desktop and back again. He seemed to study Conrad's expression. "It's the Moon, lad. Luna. The Earth's moon."

"Oh. I thought the Moon was bigger than that."

Again, that studying look. The king's head was nodding slowly. "So it is, lad."

Fortunately, Bascal came to the rescue, cutting in with a: "Hello, Father. I've missed you at camp."

King Bruno seemed to ponder this for a couple of seconds. "Hmm. Yes, well we've missed you as well. But that's hardly the point here, is it? You've misbehaved, and will be punished for it."

"Yes, Father," Bascal agreed, his voice maybe a bit too chummy.

Bruno frowned at that, and tried for a moment to rise from his chair, before looking around and realizing that the room was packed, that Conrad and Bascal weren't smooshed up against him out of pure admiration. He scanned the assembled faces, looking almost puzzled. Finally, he directed his attention at Bascal and spoke again. "Your mother and I would like to know *why*. You understand this? We've invested a great deal of time and love and energy in a creature which has become highly resentful. An explanation would help."

Bascal remained polite this time. "You've heard the explanation, Father. I've been shouting it from the rooftops for four years now. It's the seriousness of it that always escapes you."

Bruno's frown deepened. "Seriousness? My boy, I've lived a long life, and these are the least serious times I've seen. War is a memory, crime is in sharp decline, and there've been remarkably few disasters—natural or otherwise—to threaten lives and infrastructure. You've never seen a time of strife, lad. You don't know what it's like."

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"No, you just refuse to see it. The strife is all around us."

"Pish," Bruno said, waving a hand. "You kids. You think teenage angst is a new invention?" Then he paused, and added, "It's awfully small in here. Perhaps the dining room would be better. Have you boys eaten?"

"We have," Bascal agreed, although it was just nachos and beer. Truthfully, another bite or two would not be unwelcome.

"Maybe a snack," Conrad said, stupidly, just as he might to any other friend's father. Then more contritely added, "Sire."

"Snack," Bruno said, pinching his chin and musing, as if this were some bold new theorem he was hearing for the first time. "Hmm."

Five minutes later, the boys were arranged around a wellwood dining room table, with Bruno at one end and Queen Tamra at the other, and Bascal squarely between them on the long side. The table would have been huge with just the three of them, but with thirteen boys and a girl it seemed cozy enough. Everyone was solemnly drinking lemonade from delicate-looking crystal goblets, and nibbling on tiny peanut-butter-and-vanilla sandwiches, and gazing out the picture window at the white sand and coconut palms, the ocean surf throwing itself against the beach, which sprawled for a hundred meters along a gentle, gently groomed slope.

It looked sultry-hot out there, but this dining room was cool in both the literal and metaphoric senses. Her Majesty was less icy than before, but still reserved and impatient with her wayward son. She did spare some attention for the other boys, asking the ones closest to her—Steve Grush and Jamil Gazzinga—if they had ever been to Tonga before.

"No, Ma'am," Steve said, as politely as you please. It seemed strange to Conrad, that a bully as transparent and, well, *stupid* as Steve should be sitting right next to the Queen, essentially ignored by her bodyguards. Even stranger that he should look good doing it. It seemed like at any moment he should leap from his chair, grab her by the head, and start delivering noogies. But here was how the worlds really worked: act like a complete asshole and you could lunch with the Queen. Jamil, for his part, looked pale and sweaty and terrified, and could only manage to grunt a reply.

Xmary also looked terrified, probably because she was seated only two places away from Bruno, and could be caught out at any moment. But the king wore a distracted, lost-in-thought kind of look, and like the queen he was mostly interested in Bascal anyway.

"So," he said to the prince, tearing himself out of some internal reverie. "You were explaining these trying times to me. Perhaps the vanilla has sharpened your righteous fury. Would you care to continue?"

And yes, Bascal did look angry when he answered, "This is precisely my point." He gestured around the room, at the table, at the tiny sandwich in his hand. "You connive a scene here to make me look like a little kid. In front of my peers, no less."

Bruno reflected on that, then nodded across the table to his wife. "Dear, is it childish to eat a sandwich?"

"I eat them every day," she answered.

"Really, every day. I didn't know that." He popped one of them into his own mouth and chewed it thoughtfully.

"Your father," the queen added, glaring mildly at Bascal, "does not connive. The very idea makes me laugh. This is good lemonade, by the way."

"The cooks have been playing with the pattern," Bruno said. "I'll let them know you like it."

"Do, please."

But Bascal wasn't finished. He glared back at his mother and said, "You know perfectly well what I mean." Then, to the king: "You were already at university

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by my age, learning physics. Emancipated. Adult."

And Conrad could see how it was in this house: emotional appeals in one direction and logical ones in the other, with human servants as well as robots and household intelligences to serve as neutrals. But really they were all together, a unified front which Bascal was busily throwing himself against.

"Orphaned, lad." the king said sadly. "Living on earthquake charity. People died back then, and not on any convenient schedule. I *wasn't* an adult; I'd much rather have been learning archery and canoeing."

"Mother was already Queen at fifteen."

"Also orphaned. And thrust into power without warning, by people who did not have her best interest in mind. It's nothing to envy, Bascal. When your semester at camp is over, you can return to a loving family. Tamra and I never had that option."

"We're going back, then," Bascal said. "To the dumping ground."

"Don't be melodramatic," the queen chided. "You may learn to appreciate the comforts of our age. Of dining with your parents, even. If not, then perhaps camp isn't so awful after all." She touched a napkin to her lips and stood up. "I have meetings, I'm afraid."

"Send a copy," Bascal snapped.

"I have," the queen replied evenly, "Several. But the day is fluid, and things keep coming up. I'll spare you the goodbye kiss." She looked around the table. "A pleasure meeting you children. In the future, kindly stay out of trouble. His Majesty will escort you to the dumping ground."

With a swishing and rustling of fabrics, she was gone. Conrad felt bemused, and somewhat torn. Tamra Lutui was easy to love: beautiful and funny, intelligent and capable. It was part of why she'd been elected—or drafted—in the first place, and the effect was at least as pronounced in person as on TV. But she *was* belittling her son's grievances, and with them an entire—and much aggrieved—generation.

"We won't cooperate," Bascal said to his father. "It wouldn't be right."

"No?" the king replied, thinking about it. "We've pulled all the humans off the planette, and replaced them with Palace Guards. From this point on, your cooperation and approval are rather moot. You're only fourteen, lad."

"Yes. And someday I'll be 'only a hundred,' and then 'only a thousand.' I'll *always* be younger than you, Father."

Patiently: "That's true, but by the time you're a thousand, the difference in our ages will be comparatively small. You're going to live forever, lads, and once you've left childhood behind there's no reclaiming it."

He mused for a further moment, and said, "You know, that camp of yours is gorgeous, probably the finest planette ever built. I would have loved . . . would have . . ." His voice trailed away wistfully. Then his gaze jumped up suddenly, and settled on Xmary. "Egad, child, are you a girl?"

"No," she replied, sounding indignant. Sounding just exactly like an indignant sixteen-year-old girl.

"Hmm," the king said, studying her for a moment. "All right. No offense meant. Shall we go, then?"

Bascal held his arms out, roadblock style, and looked around warningly. Nobody move.

Seeing this, Bruno nodded. "Hmm. Yes. Well, if you won't cooperate, you won't cooperate. I was young once, I remember how it was. We'll have the guards drag you kicking and screaming through the fax, all right? We'll all preserve our honor that way."

Then he looked right at Conrad and winked—a conspiratorial gesture of such portentous friendliness and condescension that the lad would, in some small way, never be the same again.

This isn't over, he thought. But for now, it is.■

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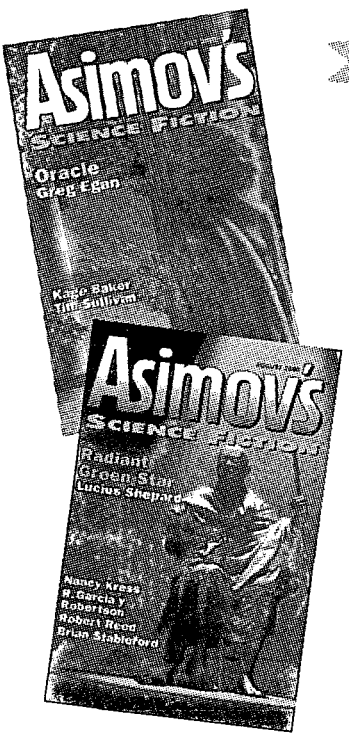

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Mindworlds, Phyllis Gotlieb, TOR, $24.95, 253 pp. (ISBN: 0-312-87876-1).
The Disappeared, Kristine Kathryn Rusch, ROC, $6.50, 374 pp. (ISBN: 0-451-45888-5).
Permanence, Karl Schroeder, TOR, $27.95, 447 pp. (ISBN: 0-765-30371-X).
Tainted Trail, Wen Spencer, ROC, $6.99, 311 pp. (ISBN: 0-451-45887-7).
Isaac Asimov: It's Been a Good Life, Janet Jeppson Asimov, Prometheus, $25, 309 pp. (ISBN: 1-57392-968-9).
The Universe Next Door: The Making of Tomorrow's Science, Marcus Chown, Oxford University Press, $26, 191 + xiv pp. (ISBN: 0-19-514382-5).
Biological Threats and Terrorism: Assessing the Science and Response Capabilities, Stacy L. Knobler, Adel A. F. Mahmoud, and Leslie A. Pray, eds., National Academy Press, $42, 317 + xviii pp. (ISBN: 0-309-08253-6).
Funny Face! Mark Rich and Jeff Potocsnak, Krause Publications (www.krause.com), $21.95, 120 pp. (ISBN: 0-87349-418-0).
The Great Flying Saucer Conspiracy, Thomas A. Easton, Wildside Press, $32.95, 271 pp. (ISBN: 1-58715-700-4).

Phyllis Gotlieb's **Mindworlds** is the sequel to her *Violent Stars* (reviewed here in October 1999) and *Flesh and Gold* (May 1998). For those of you who haven't followed the series, it began with the discovery that the criminal organization known as Zamos was running an extensive system of brothels, casinos, and other operations using genetically engineered slaves. *Flesh* tossed a major monkey wrench into the works, and by *Violent Stars,* Zamos was on trial, with its manipulations of humans and the dinosauroid Khagodis and its malign alliance with the insectile Ix, who have long enslaved the amoeboid Lyhhrt (superlative bio and mechanical engineers) as hosts for their eggs, all coming to light. At this point the Ix intervened, kidnapping the child of the Terran ambassador to Khagodis and demanding an end to "prosecuting and persecuting our people."

Needless to say, that wasn't what happened. Ned Gattes, hero of the first book, rescued the child, while Hasso, the Khagodis archivist, unearthed the truths that made sense of it all. It all made an active, violent, exciting tale of conspiracies and schemes with what looked like a very satisfactory conclusion.

Since we now have volume three in hand, the conclusion was something of an illusion, but what the heck. We all know that villains do not give up easily, and here they are again. Zamos may have lost its head, and the Ix may have vanished, but evil is an octopus with a million tentacles that keep on twitching even after they lose their master. There are riches to be had, and weapons in caches, and a plot is afoot to raise an army and invade Khagodis, apparently masterminded by rogue Lyhhrts.

Fortunately, there are also Lyhrrts faithful to the cause of peace, and soon

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Ned Gattes is enlisted once more, along with the Lyhrrt-made robot Spartakos, to infiltrate the growing army. Meanwhile, on Khagodis, Hasso is encountering other aspects of the plot in the form of a selfish lordling with designs on his neighbors' lands and women.

This one is less satisfying. The characters move through events that are interesting enough but nevertheless largely peripheral to the real events, which transpire offstage. Here the conflict is between Lyhrrt factions, and we hear of more than we see. The theme is the struggle of an oppressed people to reclaim command of their own destiny, the conflict of violent extremists versus those of more cooperative bent, and the obvious truth that cooperation is better in the long term.

And this time, it really does look like a conclusion.

In the world of Kristine Kathryn Rusch's **The Disappeared**, humanity must deal with a number of alien societies. These aliens are powerful enough to deal with as equals (or better), and treaties dictate that if a member of one species offends against another's laws, on the latter's turf, the offender is subject to the latter's laws. Ignorance of those laws is of course no excuse, and if penalties seem draconian or bizarre—the Wygnin, for instance, seize children to pay for the parent's crimes—that's just too bad.

It's also an opportunity for "disappearance agencies," which will, for a fee, help one leave an old identity behind—career, money, property, name, loved ones, history, and all—in order to start afresh, presumably beyond the reach of alien justice.

So here is Ekaterina Maakestad, leaving everything behind to flee the Rev, who want to put her in a prison camp. We don't know her crime, but we do know she is a lawyer, a competent and determined lady, and a customer of Disappearance, Inc. She will become a low-echelon worker on Mars, which is so dominated by the Disty that the Rev do not go there. Or will she? The DI ship that is taking her away meets a Rev ship in space, and she overhears enough to know she is being betrayed.

Here is Sara with her associates Ruth and Isaac. They too are on a DI ship, fleeing the Disty, when they see out a porthole a Disty ship. Sara rushes to the control room and finds the crew gone.

Here is Jamal, househusband with a beloved wife and child. When he checks on the child one evening, the child is gone, the crib empty.

And here are Miles Flint and Noelle DeRicci, detectives on the police force of Armstrong dome on Luna. They're having a bad day, for first there is a yacht towed in with three bloodily slaughtered bodies to investigate. The pattern is familiar: a Disty vengeance killing, perfectly legal as long as they have warrants.

Then there's the Wygnin ship intercepted leaving Luna with a couple of human children aboard and no warrants.

And here's a frantic single woman crashing her yacht—identical to the blood-stained scene of Disty justice—claiming to be fleeing the Rev, and at the first opportunity slipping out of police custody.

The kids upset Miles the most, for they are innocent. But treaties are treaties, and if the Wygnin can prove their claims, he must let them go. The Disty and Rev cases are more acceptable, but still, the two yachts involved are identical. Something funny is going on, and he must find an answer no matter how much he hates his job and his age's notion of justice.

Rusch's tale is the story of Miles's progress toward figuring out what that "something funny" is and what he can do about it. As we expect from her, it's a humane tale, with emphasis on human characters and human predicaments. We empathize, we identify, and with Miles we yearn for a solution that will

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save the children and even shield the not-so-innocent adults from alien ideas of justice that strike us as unreasonable.

There is of course a parallel here to our more familiar world. Right here on Earth, we have a multitude of cultures, each with its own list of mortal offenses and prescribed penalties. We call it "diversity" and claim to believe that it must be respected. We have treaties and extradition systems and cases that alarm us horribly (I think of the American kid who got caned in Singapore a few years ago for an offense that here would have earned him no more than a smallish fine or a few days of community service). And our own country seizes people in other lands to meet our ideas of justice. Others don't seize U.S. citizens on U.S. ground, but then we don't have to deal with other countries as equals, do we?

(I know, we should and we say we do. But we swing a disproportionate amount of weight, and we don't often hesitate to use it. Since Rusch doesn't mention any impositions of human law on Disty, Rev, or Wygnin worlds, perhaps she is, in a very familiar SF move, inverting the pattern that we take for granted here and now.)

Whatever. *The Disappeared* is a very readable, very thought-provoking novel that lives up to every expectation we have of Rusch and her considerable talent. Buy and enjoy.

A year and a half ago, I praised Canadian Karl Schroeder's *Ventus* as a satisfyingly meaty grand adventure that attempted to resolve the essential dichotomy between humanity and nature by investing nature with artificial intelligence and nanotechnology. Since technological solutions inevitably carry with them risks—here the possibility that nature and humans could find themselves at cross-purposes, with nature having the upper hand, or that the AIs could turn inimical, there was plenty of room for story.

Now he's done it again. In **Permanence**, Schroeder offers several intriguing ideas. One is that human civilization will expand into space and find homes both on the "lit" worlds that circle suns like our own and on the "halo" worlds to be found around the vastly more numerous brown dwarfs. Initially, both types of worlds are linked by "cyclers," slower-than-light starships that pursue vast looping courses through the deeps. Worlds where several cycles meet prosper mightily from trade. And the monks of the Cycler Order manage it all to sustain as nearly permanent a civilization as possible.

Yet Earth has come up with FTL ships, as well as a "Rights Economy" (RE) that is a *reductio ad absurdum* for the idea of micropayments now circulating as a way to handle paying for intellectual property downloaded from the Internet. Here, everything has been dusted with nanotech tags that broadcast identity and value; to sit in a chair or to look at a view is to obligate oneself to send a tiny payment to the Rights Owner. Since Earth is spreading the RE by conquest and making itself and its minions the Rights Owners for everything in sight, the hinterlands are being beggared. Meanwhile, the FTL ships go from lit world to lit world, shifting the patterns of trade. The halo worlds are left on their own, and the cyclers have grown fewer.

So meet Rue Cassels. Just a teen, she has grown up on Allemagne Station, a comet-miner. The stationers are hanging in there despite the decline of the halo economy, but things do feel a bit desperate. And it doesn't help a bit that her parents have died and her abusive older brother, Gentry, is doing his best to steal her share of the inheritance.

She's a determined kid. She grabs a ship, planning to head for the nearest halo world. But then she spots what looks like an unclaimed comet and stakes her claim. Much to everyone's surprise, the "comet" turns out to be a cycler. But it doesn't answer hails, and

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when in due time Rue leads a crew to take control, it turns out to be an alien starship. A cycler, to be sure, but not a human one. And quite, quite empty. She names it *Gentry's Envy*.

The funny thing is that no one has been able to find any aliens. Their ruins are out there, as we learn when Schroeder turns his attention to Mike Bequith, assistant to Professor Laurent Herat, who has long studied them. Soon it is clear that the aliens also wished to establish permanent civilizations but failed. There was a tendency for scattered worlds to vary, perhaps even for a species to split into several, and for war to bring down even the most glorious of empires. The Chicxulub sought to solve the problem by destroying all potential competition (including the evolving dinosaurs on Earth 65 million years ago), but they too vanished. Permanence is difficult to achieve.

But there is Chicxulub and other writing on Rue's alien cycler. And the *Envy* does not seem to be more than a few decades old.

At the next stop—an RE world—an RE military ship tries to take over the investigation and the *Envy*. The RE too wants permanence, and Admiral Crisler has already picked up Herat and Bequith as well as a squad of other scientists. Rue maintains control with some difficulty even as people begin to die around her.

Why are they dying? Where did *Gentry's Envy* come from? Why does it exist?

The answers, of course, have something to do with permanence, but I'm not about to flesh that statement out very much. Suffice it to say that nothing that is static can last forever. Even mountains erode. But processes can endure, so long as they avoid rigidity.

And as we saw in *Ventus*, Schroeder is something of an ecologist.

Like *Ventus*, this is not one to miss.

Wen Spencer easily lives up to the promise of her first novel (*Alien Taste*, reviewed here last February) with the sequel, **Tainted Trail**. The backstory is that centuries ago, the alien Ontogard arrived on Earth. Their aim was more than conquest, for they conquered by infecting local lifeforms and replacing their cells with their own. The result of such an infection is a "Get." This is the perfect disguise for an invader, even if it cannot work until the Ontogard first use a bit of genetic engineering to create a hybrid "breeder" that can give rise to a variety of local that can be more easily and successfully infected. But among the Ontogard was a mutant rebel, Prime. He sabotaged the mission, killing most of the invaders. And before he died himself, he infected a local wolf who became Coyote and in due time infected enough humans to form the Pack, dedicated to warring against Hex, the surviving standard-issue Ontogard villain, and his numerous evil Gets. He also sired on a local woman of the Cayuse tribe a fully fertile breeder.

And so was born hero Ukiah Oregon. In *Taste*, we learned that he had been a wolf child until caught in a trap and adopted, that he had the ability to detect and analyze DNA the way we might a pungent odor, that when he is injured, lost blood or bits of flesh turn into small animals, and that he can recover from thoroughly mortal wounds. He also doesn't remember his origins (memories run away with lost blood or flesh).

He's a strange fellow, but he's a nice guy and a very suitable hero. It doesn't hurt a bit that he's a partner (with Max Bennett) in a private-eye agency, where he functions as a superlative tracker of missing persons (that ability to detect DNA means he can follow trails easily). In *Trail*, a friend of Max's needs help. His niece, Alicia, has vanished from a campsite near Pendleton, Oregon. Now Ukiah and Max are on the way to see if they can track her down.

It doesn't take long to learn that something strange is going on. Hikers have

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been disappearing, and locals have been burning up in their houses. The Kicking Deer clan of Cayuse Indians is very sensitive about anyone looking into a wolf boy, "Uncle," who was murdered in 1933. And Ukiah is hot on Alicia's trail when he is shot with a high-powered rifle.

Before Spencer is done with this one, Ukiah knows a great deal more about his past, he has a few more friends, and he looks like a better hero than ever.

Does he save Alicia? Uh-uh. That would be telling. You have to read this one yourself. All I'll say is that you will enjoy the task. Spencer writes with assurance and verve and is only getting better.

By now everyone has heard what Isaac Asimov truly died of on April 6, 1992. As Janet Jeppson Asimov reveals in her epilogue to **Isaac Asimov: It's Been a Good Life**, Isaac acquired the Human Immunodeficiency Virus (HIV) from blood transfusions when he had bypass surgery in 1983. At that time, AIDS was new, HIV was not at all well understood, and there were no tests for HIV in blood collected for transfusion. Symptoms followed, but Isaac was not properly diagnosed until 1990.

The tragedy of this tale is hardly unique, even at Isaac's level of fame. Nor is the tragedy ameliorated by the fact that Isaac himself could say he had a good life as an immigrant child who grew up to do precisely what suited him best, and to do it very successfully. That "good life" is well portrayed in this book, which Isaac's widow assembled as a collage of excerpts from his three-volume autobiography, his letters to her, his favorite story ("The Last Question"), and a final pieced-together essay on science as "A Way of Thinking."

The book glows with her love for him. It thus speaks to us all as a paean to a man. But it is also a paean to an icon of the twentieth century, a psalmist for an age of science. And of course a central figure in the pantheon of science fiction.

Give this one an honored place on your bookshelf.

"New ideas," says Marcus Chown, once a Cal Tech radio astronomer and now cosmology consultant to *New Scientist*, "are the stuff of science." We might add that they are the stuff of science fiction as well, at least of the sort of SF found in this magazine. So pick up a copy of Chown's **The Universe Next Door** and see what scientists are thinking about time that runs backward, infinitely layered realities, multiple universes, quarks as loops of time, extra dimensions, mini-black holes, mirror matter, creation, the origins of life, the prospects for ETs, and the possibility that we could find alien artifacts in our solar system.

Not so new ideas? At least to *Analog* readers long blessed with the columns of John Cramer (not to mention all the rest of the mag's fact and fiction)? Well, maybe. But Chown has a remarkably smooth, deft style that must appeal to readers of all sorts in much the same way that the late Carl Sagan's work did while pushing the imaginative envelope as much as Hawking's *A Brief History of Time*. This is a readable and enticing exploration of the wildest ideas of legitimate science.

Great fun for all.

The "Summary and Assessment" at the start of **Biological Threats and Terrorism: Assessing the Science and Response Capabilities** begins with "In the wake of September 11 and recent anthrax events, our nation's bioterrorism response capability has become an imminent priority for policymakers, researchers, public health officials, academia, and the private sector."

This is precisely the reason why I think the book deserves mention here. Bioterrorism has become a genuine threat, and one that we are ill-equipped to deal with effectively. To be better

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equipped requires that we understand the nature of the threat; our present abilities to detect biological attacks, prevent illness (vaccines), limit spread (quarantine), and treat victims (drugs); and the need for additional response capability. Toward this end the Institute of Medicine held a workshop of the Forum on Emerging Infections. The presented papers are offered here, and they are illuminating.

In September, I let Mark Rich "use" me to tell you how versatile he was as musician and toy expert as well as *Analog* writer. He's still at it, and his latest book for toy collectors is **Funny Face!** which is dedicated to the ancestors, origins, iterations, imitations, and descendants of Mr. Potato Head. Since this is a science fiction mag, there has to be an SF link in here somewhere, right? So how about "Space Faces," 1953, which let the kiddies turn fruits and vegetables into Little Green Men? Or the "Spudettes, Potato-Head Pets," which should certainly ap-peel in an age of genetic engineering. During the Apollo era, there was "Mr. Potato Head on the Moon," complete with onion aliens. Speaking of which, you could get some *very* weird effects with non-potato veggies!

As before, loads of pictures, descriptive material, historical notes, and values for the attention of the serious collector.

I can hardly review it, but I can certainly tell you it exists: My **The Great Flying Saucer Conspiracy** is now available from Wildside Press (www.wildsidepress.com; discounts available at some online booksellers). It pretends to tell you what the saucer people are really up to and why. Mike Resnick accuses me of making science fiction fun again. ■

We can easily forgive a child who is afraid of the dark. The real tragedy of life is when men are afraid of the light.

—Plato

One of the secrets of life is to keep our intellectual curiosity acute.

—William Lyon Phelps

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BRASS TACKS

Dr. Lovett:

Your article on altitude research, although interesting, left me with some concern for the "facts" in your presentation. You seem to use the terms hypoxic and anoxic as synonyms for one another. Yes, those two words do both describe the effects of oxygen deprivation on the human body. I feel quite strongly, however, that the treatment of anoxia (the lack of oxygen due to a rarefied atmosphere or some other physical restriction) is significantly distinct and different from the treatment of hypoxia (oxygen deprivation as a result of hyperventilation). This may be an insignificant difference in your mind. It is, however, a matter of life and death to the practicing fighter pilot. If, for example, he is flying at 40,000 feet and suddenly becomes nauseous or has a headache from hyperventilation and applies copious quantities of 100 percent oxygen, the condition is exacerbated, and he will become unconscious and may die from that remedy. If, on the other hand, he is truly suffering from altitude sickness and its consequent oxygen starvation, but interprets the symptoms as being due to hyperventilation whereupon he begins to "rebreathe," he is also going to lapse into unconsciousness and may die from that remedy.

The point (and if it was made in your article, I apologize for my inability to recognize it) is that the transition of gasses into solution within the bloodstream is dependent upon Boyles Law, specifically the effects of partial pressures of gasses. When the carbon dioxide in the lungs is depleted by hyperventilation, the blood system is unable to absorb the oxygen necessary to sustain life and function. This malady (we referred to as hypoxia) requires a remedy of replacing the carbon dioxide levels (we referred to as rebreathing). Adding oxygen is counterproductive and in effect may be lethal. This has little or nothing to do with the rate of maximum oxygen consumption when working, or the size of the body that is involved—it is in fact just the mere lack of partial gas pressure required to cause the available oxygen to go into solution with the blood.

I am no physician, nor do I possess degrees of any kind in the physiology of the human body. I am, on the other hand, a retired fighter pilot of some twenty-odd years of experience, and these observations are the best that my memory can produce from some twenty annual courses in aviation physiology. Of course, my last experience of this nature was some thirty years ago and it just may be that science has advanced during that time frame to such an extent that all these observations are no longer valid; but I don't think so. On the other hand, it could be just the results of my "some-timers disease" (sometimes I remember and sometimes I don't).

J.L. Symonds
Maj. USAF, Ret.

P.S. Your observations about oxygen concentrators was most interesting. This seems to me to be an effort whose time is well past due, a little like the way that we tend to treat the development of the electric car.

* * *

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The author replies. . .

Maj. Symonds is correct in identifying two mechanisms by which pilots can lose consciousness at high altitude. But I did have my facts correct. What he calls "hypoxia" is more conventionally referred to as hyperventilation. According to Webester's Medical Desk Dictionary, "hypoxia" means oxygen deficiency. "Anoxia" means severe oxygen deficiency. That is how I used the terms in my article. The Air Force may well have its own terminology, but I suspect that he's confused hypoxia and hyperventilation.

Maj. Symonds' discussion of first-aid for anoxia and hyperventilation is correct, but oversimplifies the physiology. Anoxia means that the body is starving for oxygen. Hyperventilation means that you've blown off too much carbon dioxide, thereby interfering with the feedback mechanisms that make the body "want" to breathe. The hemoglobin will still absorb oxygen, but the body thinks it's been breathing too much and wants to shut down, either by restricting the volume of each breath or ultimately by passing out.

You can hyperventilate without becoming hypoxic. Anyone who's ever taken a few too many deep breaths at sea level has experienced exactly this. The primary risk to pilots would appear to be that if you take the wrong response, you've failed to address the real problem, and risk passing out and crashing before you realize your error.

Boyles Law and partial pressures are relevant, but not the be-all and end-all of oxygen transport. Maximal oxygen uptake is the "gold standard" of exercise physiology, and the impact of altitude on it is highly relevant to how much work you can do at elevation.

Dear Dr. Lovett,

I have just finished reading your article on altitude research in the June 2002 issue of *Analog*, and thought that you might like hearing my personal experiences.

First, a bit of biography. My return address tells you that I live in La Paz, Bolivia, where I have retired. I was born in New York City in 1930, and until May 1965, when the United Nations sent me to La Paz to supervise the installation of the first computers in the country, the highest altitude I had experienced was Denver, Colorado where I worked for about two years. (Incidentally, I did visit Climax, but just for a few hours.)

As you may know, the airport for La Paz is at an altitude of 13,500 feet. The city itself is quite a bit lower. (My house, in the southern zone of the city, is at 10,800 feet.) One of the computers I installed was for the Bolivian Mining Corporation, a state owned enterprise, and in connection with "COMIBOL," I had numerous occasions to travel to most of the mines in Bolivia. Travel to the mines at that time was strictly by auto. I have quite often been to higher altitudes, the highest 18,050 feet. At that time I was a heavy smoker, one pack per day of Pall Mall unfiltered. I do not recall ever experiencing any symptoms of altitude sickness—"Siroche," as it is called here.

I am now 71, in godawful shape physically, weighing much too much, and leading a fairly sedentary life. I still have never experienced the slightest discomfort despite returning to New York for frequent extended visits to my family.

I think, therefore, that I would make an ideal candidate for a life in a space colony. Would you care to recommend me? I would accept instantly.

I would also recommend the high plains surrounding La Paz as an ideal training ground for high-altitude troops.

There would certainly be less need for periodic R&R leaves. La Paz has most of the amenities. (The few it doesn't have are supplied by Amazon.com)

Morton W. Kahl

The author replies. . .

You have my vote! Can I tag along?

Dear Dr. Schmidt,

This was a fascinating article. Dr.

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Lovett's observation that his high-altitude tolerance bettered with age reminded me of an article some years back in *New England Journal of Medicine* (sorry, I do not as yet have the citation) which addressed the paradoxically higher death rate from Spanish Flu right after WWI in young, fit persons compared to the lower death rates in the elderly or less fit or even ill persons. The author postulated that the high cardiac output in young, fit persons exacerbated the adverse mechanism caused by the virus, which is to increase lung capillary permeability which leads in turn to pulmonary edema, just as occurs in HAPE.

Thanks for a provocative article.

John S. Loder, BA, CCRA
Senior Regional Clinical
Research Associate
PRA International Home-Based

The author replies. . .

Thanks for an interesting tidbit. I'm not the only one to observe that altitude tolerance improves with age (with middle age, anyway). An M.D. friend has also heard it reported at a wilderness medicine clinic. But I've never before heard anyone postulate a mechanism for it.

Dear Dr. Schmidt,

Regarding your June editorial "Perspective," I thought it was good. As others have no doubt informed you, the author of *The End of History* and *The Last Man* was Francis Fukuyama. His 1992 book was based on his 1989 essay. In the essay, Fukuyama did not suggest that there would be no future conflicts. Instead, he argued from a Marxist perspective that history is a struggle between economic orders and that the then-recent collapse of East European communism meant that Western liberal democracy had won. History, being a struggle between socio-economic orders, was over. What events the future held would only be "mopping up" (my words).

The ironies of Fukuyama's argument are obvious now. Fukuyama's premise was to dismiss Marxist socialism as failed, but his reasoning itself was thoroughly Marxist. No wonder he got it wrong. Further, Fukuyama dismissed nationalism, fascism, and religious fundamentalism as already discredited; they would not matter in the future, he said. Wrong, wrong, and like way wrong.

Francis Fukuyama remains a highly-respected political thinker, an occupation whose predictive horizon seems comparable to a weatherman's. In fairness to him, your comments about popular attitudes in the post-Cold War period show that Fukuyama's irrational optimism was widely shared.

I disagree with the last paragraph of your editorial in which you argue that "if we care about preserving the human race, we must get some of it off this planet."

Sorry, but that won't help. I strongly support a vigorous program of space exploration and colonization, but I realize it will not protect us from terrorists. I am confident that we will still discover ways to annihilate ourselves.

Technology that makes off-world colonization possible can be used for mass-murder. Consider a scenario in which terrorists hijack not four airliners, but four spaceliners. They crash them not into buildings, but into city centers. They crash not at 500 mph, but at 80,000 mph. Instead of killing thousands, they kill hundreds of thousands, perhaps even tens of millions. Not much of an improvement, hey?

If we care about preserving the human race, then we cannot afford to luxuriate in the illusion that anyone is safe if someone else is not. My reasoning is as pragmatic as it is moral: injustice has practical consequences as well as moral implications.

Consider how crazy some of us were for a while after that black day in September. Now try to imagine having to live through black years, violent, inse-

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cure, oppressive lifetimes. If we can lose our cool so quickly, imagine how hard it must be to keep one's cool day in and day out through miserable, hopeless years. Desperate, angry people are not known to behave rationally. They look for villains, assign scapegoats, and lash out at those around them. The proliferation of nuclear weapons is a well-perceived threat; September 11th demonstrated the danger from the proliferation of people with nothing to lose.

Nothing justifies what happened to us on September 11th; we did nothing to deserve it, but we didn't need to do anything to become a target. Our wealth and security and indifference are sufficient to attract the animosity of impoverished, insecure, desperate people. Mere distance does not deter them. With nothing to lose but miserable lives, they are a danger to everyone.

If we don't want to be a target, we need to be seen acting justly, our fairness must be real and understood. Mere absence of guilt is not sufficient. Those in dire straits do not often give the benefit of the doubt to anyone. There are no guarantees, but our best hope for a secure future is by making sure we all share in that secure future. We cannot purchase our security at the expense of others; those we leave behind are not likely to leave us alone. There is no coercion that will deter a suicide bomber and no security protocol someone can't break.

However, providing for this future is a task whose complexity and cost are orders of magnitude greater than the already-humongous costs of space exploration. The gravity-well of human need makes the Earth's gravity-well seem insignificant. Science fiction used to feature quasi-utopian futures, but now our view of the future tends to be darker. How did we think utopia could be approached? By wishing for it? It requires hard work. Perhaps our conception of the future is bleaker because we have realized how hard it would be to actually seek a just future. So instead we dream of sending our plague-ships to the stars.

In the short term it always seems easier to flee a problem than to face it. Our ancestors fled across oceans, we flee to the suburbs, and plan to send our descendants to the stars; all to no avail. Nature demands that the bill be paid, always. The same means that enable us to flee enable our problems to follow us. We can pay the bill now or our children will have to pay it later, but the price only goes up.

Sean M. Samis

You're right that getting some of the species off-planet won't guarantee *survival and that the only long-term solution is learning to live better. But getting some of us elsewhere* will *help, at least in the short term, by making it less likely that any action affecting even a large number of us—say, a planetful—will affect* everybody.

Dear Stan,

In your June issue editorial, last paragraph, you said, "If we care about preserving the human race, we must get some of it off-planet." I have examined this concept a number of times during my lifetime, and still can't answer the question, "In the cosmic, or even planetary sense, is human life such a valuable asset that anyone should care if it perpetuated?"

Most of the SF stories which deal with the subject assume that everyone is of a like mind when dealing with this concept, and each of us would go to any extreme to insure that our seed is scattered throughout the Universe. I may be an exception to the rule, but I wonder why I should feel this compulsion.

Is it a "manifest destiny" of the animal that insists that in the progression from simple to complex, we must further evolution ad infinitum without interruption?

I would really enjoy hearing your thoughts on this subject, perhaps in a fu-

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ture editorial . . . but don't wait too long: I'm approaching my 80th birthday.

Bryan Nicklin

In the cosmic, or even planetary, sense, it probably doesn't *matter whether human life is perpetuated. It does matter to most humans, though, and my statement that* if *we care about preserving the human race we must get some of it off-planet seems logically very straightforward and hard to refute. Whether and why we* should *care is another question entirely, which I didn't get into at all!*

Dear Stan,

Nuts, to you.

But they are not, though so you called them in your June "Perspective." What they are is what they are better called: fundamentalist or radical. Which mean the same thing: basic, to the root. To the root of their beliefs, that is; they actually *believe*—wholeheartedly—what they say they believe; they are willing to devote themselves totally to these beliefs, which does not make them nuts. Rather, your name-calling is an evasion, an attempt to avoid knowing that their beliefs are so very like what you claim to believe, but grant little more than lip service six days out of seven; you do not take seriously what you claim to believe.

To be sure, there are among you—some very few—who do take seriously what they say and think and believe. These domestic "nuts," the homegrown "lunatic fringe," and "fanatics"—seen in action on the nightly news—these believe, deeply, just what you only claim to. By your own professed beliefs, *they are right*; you cannot argue against them; they are consistent and logical where you are neither. That is why you can do nothing but say they are nuts.

They cannot be fought on their own terms. They can be fought only if you discard the unfounded superstitions which you share with them, and as well that entire class of philosophy which makes such notions possible. But you will not, for to do so would contravene the intellectual trend of over a century. So you fight them physically, having already surrendered to them in the realm of ideas.

And *you* would call *them* nuts?

Douglas L. Houser

I've read your letter several times and still can't figure out just what point(s) you're trying to make. One thing that does seems to come through, though, is the idea that depth or sincerity of belief is an intrinsic and powerful virtue. It isn't; a strongly held belief is a good thing only insofar as the belief is correct and not harmful to its holder or others.

Dear *Analog*,

While the quantum computer may make use of novel computing elements, it does not actually appear to be a "new kind of computer." Although operational details in the column are sketchy (as would be expected), a quantum computer seems to be nothing more than a new method of implementing a good, old-fashioned analog computer. Analog computers have a long and honorable history, but in modern times have been largely superceded by digital computers. The first analog computers were mechanical (slide rule, Norden bombsight) while more recent ones tended to be based on electronic components (differential analyzers). An analog computer can be constructed from any physical system whose natural characteristics can be interpreted as a model (or analog) of the problem to be solved. "Programming" an analog computer consists of physically constructing the analogy system and setting the initial conditions. The system is then released to operate and at various points as the system evolves, or at a final equilibrium point, the results are obtained by sampling the physical state of the system.

The quantum computer appears to

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share the advantages and disadvantages of earlier analog computers. The primary advantage of an analog computer is its impressive speed in finding a solution once the system is released. Against the solution speed must be placed a list of disadvantages: (1) The time required to "program" the system for a specific problem can be substantial, often involving the destruction of a previous "program" and physical reconfiguration. Because of this, there is usually no way to "save" such a program short of building a new computer. Thus the total "solution time" may actually be quite long. (2) The limitations on accuracy imposed by the instrumentation used to sample the results and the noise in the physical system itself. (3) The limited utility of such computers. While analog computers can be really good at solving certain classes of problems, they are totally useless for most everyday problems. Electronic analog computers are really good at solving calculus problems involving integration and differentiation but addition and subtraction are much more difficult. Thus they are no good for accounting or e-mail. In order to justify the expense involved in building such specialized computers in the first place, one must have a whole bunch of similar problems to be solved or a really urgent need to solve a few problems. This, of course, describes the situation of the National Security Agency.

As for a "quantum coprocessor," it should be noted that in the early years of digital computers, attempts were made to create "hybrid" computers which combined analog circuitry with digital circuitry. However, as general purpose digital computers became faster and cheaper, it was discovered that the analog sections were an impediment and were eventually discarded. Digital programs were written which actually simulated the operation of the analog portion so that the engineers could continue to think in analog computer terms. Because of his desire to use quantum computers to solve quantum problems, it appears to me no analogy is involved. What Dr. Cramer really needs is a good digital interface to the real (?) quantum world.

David A. Bridger
St. Louis, MO

Dear *Analog* Editors,

I have a question concerning Mr. Schmidt's book, *Which Way the Future?* (a very good book I might add), and was wondering if *Analog* had every addressed it. In "Nature ~~versus~~ and Nurture," the key idea is that human behavior is the product of nature and nurture. In "Foolproof," the key idea is that the blame for foolish behavior should be placed on the fool himself, i.e., people should be held responsible for their actions. If behavior is the solely the result of nature and nurture, then holding a fool responsible for his actions is to hold him responsible for the Laws of Nature and for the actions of those around him. Has *Analog* ever published an article that reconciles these two ideas?

M. Swihart

There's no contradiction: the apparent discrepancy comes from the word "solely" that you inserted before "the result of nature and nurture." Behavior is the result of decisions *made by the individual, and human beings can learn principles for making decisions. My point in "Nature ~~versus~~ and Nurture" was simply that individual character, including skill in decision-making and propensity for particular types of preferences, is influenced by both nature and nurture, not one or the other. Those influences may make it easier or harder for an indivual to make good decisions, but that does not absolve him or her of the responsibility for doing so. The last line of your first paragraph, or some variation of it, has been used far too often as an excuse for shirking individual responsibility, and civilization simply can't afford to*

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do that.

Dear Dr. Schmidt,

Here's a suggestion for an editorial tirade (or at least a "top 10" list):

The 10 (or 25, or 100 . . .) most common overworked ideas that occur in the submissions to *Analog*. The cliches you keep seeing over and over and over and over again . . . the things that make you roll your eyes and say "not *this* again."

This would be amusing to the readers (and cautionary to the writers . . .)

M. Hopkins

* * *

Great idea, but I've already done it, in "The Old Refrains" (November 1985) and later an expanded version called "The Ideas That Wouldn't Die" in Writer's Digest *(1989; reprinted in the book* Writing Science Fiction and Fantasy, edited by the Editors of Analog and Asimov's, *St. Martin's Griffin, 1991), Perhaps surprisingly, a similar grumble list compiled today would be quite similar, so aspiring writers would still do well to read it.* ■

O! many a shaft, at random sent
Finds mark the archer little meant!

—Sir Walter Scott

It is one thing to show a man that he is in error, and another to put him in possession of truth.

—John Locke

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22–24 November 2002
ORYCON 24 (Oregon SF conference) at Doubletree Hotel Portland Columbia River, Portland OR. Guest of Honor—Susan R. Matthews; Artist Guest of Honor—Lee Seed; Editor Guest of Honor—Martin H. Greenberg. Registration—$40 until 31 October 2002, $50 thereafter. Info—OryCon 24,Box 5703, Portland OR 97228-5703; 1(360)696-3821 or 1(503) 620-3441; all.wilsonsage @attbi.com or laceyax@bigfoot.com; www.orycon.org/orycon24

29 November–1 December 2002
LOSCON 29 (Los Angeles area SF conference) at Burbank Airport Hilton and Convention Center, Burbank CA. Guest of Honor—David Weber; Artist Guest of Honor—Nene Thomas; Fan Guest of Honor—Patti Wells. Registration—$40 until 31 October 2002, $45 at door. Info—loscon29.info@loscon.org; www.loscon.org/loscon/29

13–15 December
2002 PHILCON (Philadelphia area SF conference) at Marriott Center City, Philadelphia PA. Principal Speaker—Connie Willis; Artist Guest of Honor—Donato Giancola; Special Guests—David Gerrold, Nalo Hopkinson, Spider & Jeanne Robinson. Registration—$40 until 31 May 2002, later rates not announced as of press time. Info—1(877)744-2315; info@philcon.org, www.philcon.org.

24–26 January 2003
MARSCON (Southeastern Virgina gaming/relaxacon) at Clarion Hotel, Williamsburg VA. Info—MarsCon, c/o Michelle Fraser, Box 8143, Yorktown VA 23693; info@marscon.net; www.marscon.net.

24–26 January 2003
VERICON (Harvard SF/anime/gaming conference) at Sever Hall, Harvard Yard, Harvard University, Cambridge MA. Guests—Patricia C. Wrede, T. Campbell, Mike Kunkel, Judd Winick, Catherine Asaro, Jeff Paris, Adam Golaski, Tee Morris, Charles Vess. Info—www.vericon.org

28 August–1 September 2003
TORCON 3 (61st World Science Fiction Convention) at Metro Toronto Convention Centre, Royal York Hotel (and others), Toronto, Ontario, Canada. Guests of Honor—George R.R. Martin, Frank Kelly Freas, Mike Glyer; GoHst of Honor—Robert Bloch; TM—Spider Robinson. Registration—Attending CAD220/USD145, Supporting CAD60/USD40, Child CAD60/USD40. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—Torcon 3, Box 3, Station A, Toronto, Ontario M5W 1A2, Canada; e-mail—info@torcon3.on.ca; URL—www.torcon3.on.ca [Note to US readers: first class postage to Canada is $0.60]

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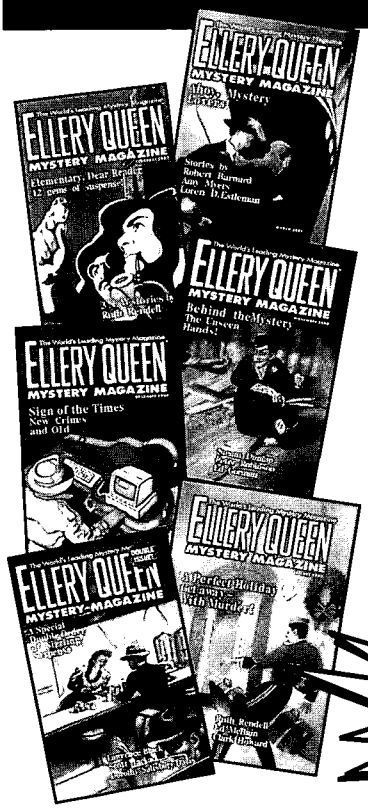

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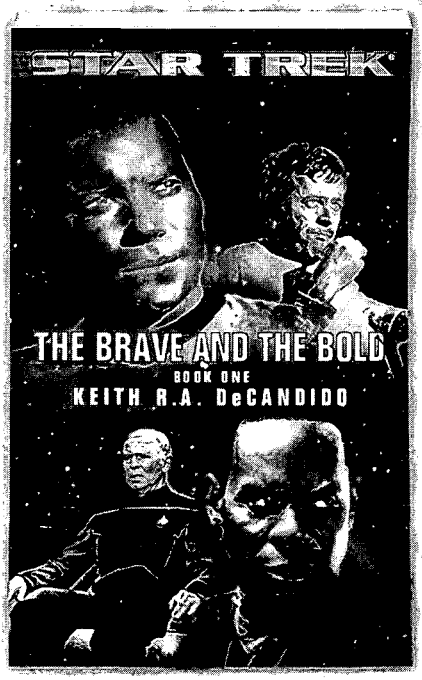

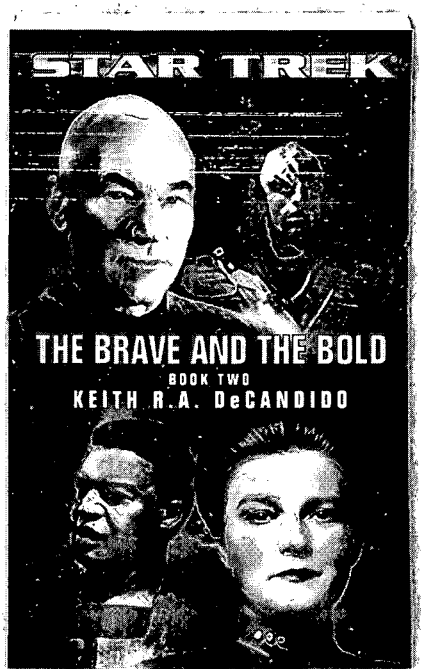

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